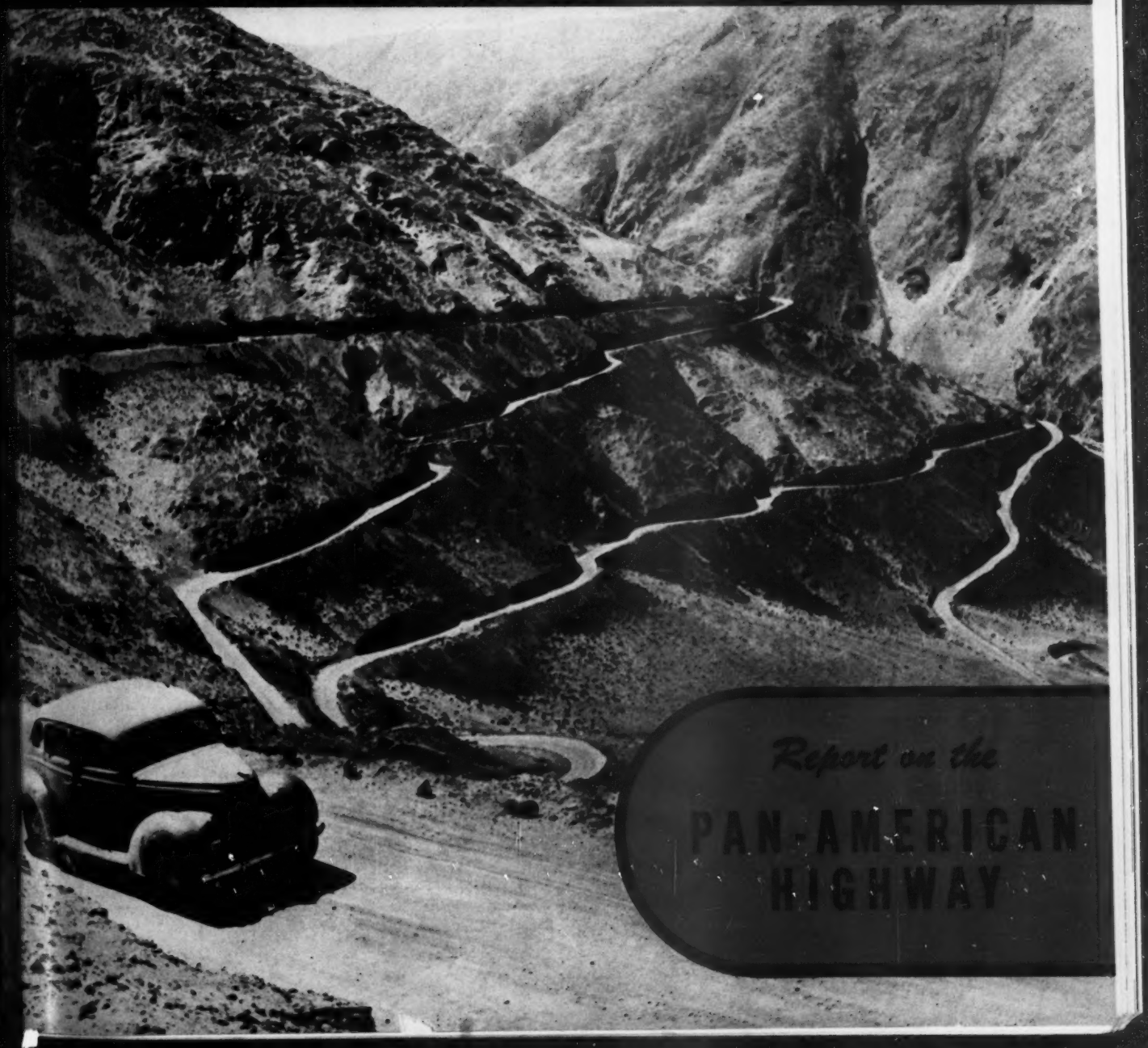
ENGINEERING NEWS-RECORD

February 21, 1946

Pan-American Highway zig-zagging over the Andes Mountains in Peru.



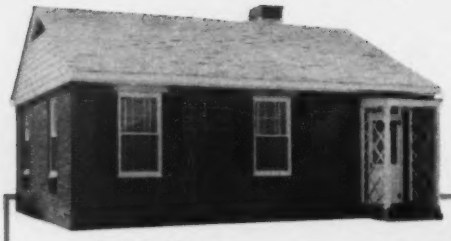
Report on the

PAN-AMERICAN HIGHWAY

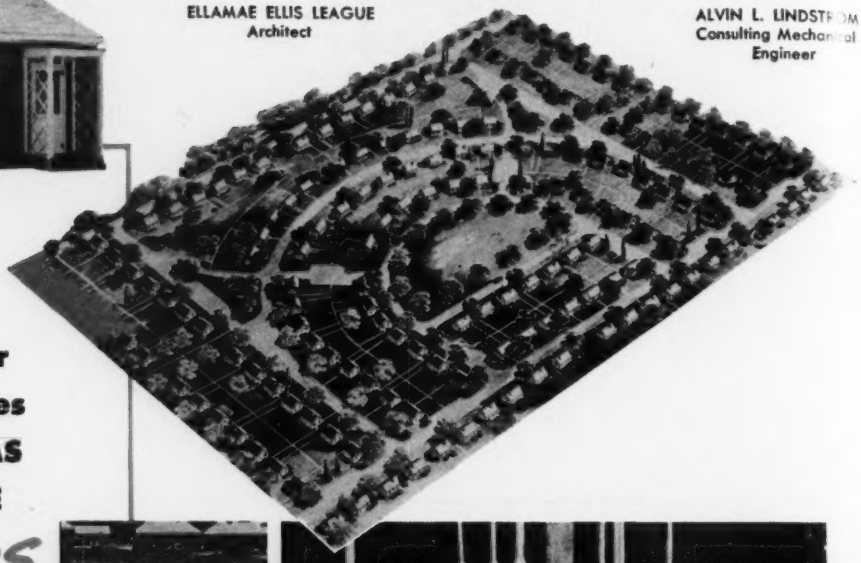
ANDERSON VILLAGE, Columbus, Georgia
Bibb Manufacturing Co., Owners

ELLAMAE ELLIS LEAGUE
Architect

ALVIN L. LINDSTROM
Consulting Mechanical
Engineer

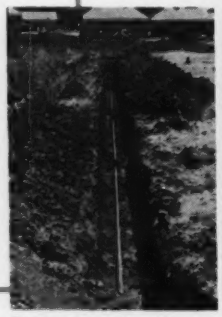


A typical home.

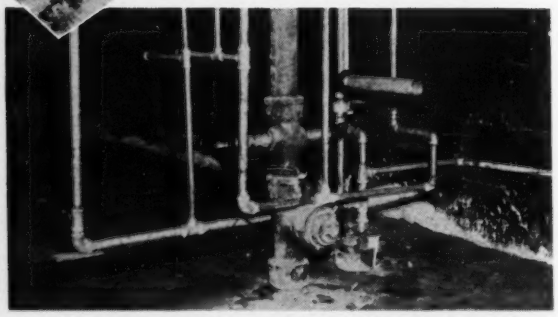


In this planned community for plant employees WATER and GAS SERVICES ARE

100% BYERS WROUGHT IRON



Underground piping is Byers Wrought Iron.



Roughing-in piping for gas and water lines in one of the houses. All of these services are Byers Wrought Iron.

With housing as it is, any move toward the projected decentralization of industry must include an answer to the big question, "What about living quarters for workers?"

In many cases, the engineering job will have to include not only construction of the plant, but of a neighboring housing development as well. In both activities, large-scale planning and large-scale operations can do a lot to combine low cost with good quality and so avoid creating a new group of slums for 1956.

This fact is well illustrated in one such project, built to house the workers of a Georgia manufacturing plant. The project includes 160 houses, placed in a landscaped area as pleasing and attractive as a middle-class suburb. Economical construction was obtained by controlling house size, rather than by compromising quality. The walls, for instance, are brick veneer on hollow tile, and interior partitions are masonry. Kitchens are equipped with refrigerator, range, water heater, and combination sink and laundry tubs. The insistence on quality and permanence is strongly reflected in the piping. All gas and water lines, underground and within the buildings, are Byers Wrought Iron.

This application of Byers Wrought Iron carries on a practice that designers have profitably followed for years, in all types of structures. The soundness of the choice is verified by experience; in many areas, wrought iron pipe is still on the job after 30, 40 and even 50 years, where ordinary materials have failed in a fraction of the time.

The reason for wrought iron's unusual service is found in its unusual structure and composition, which are duplicated by no other material. Tiny fibers of glass-like silicate slag are threaded through a body of high-purity iron. These fibers halt and diffuse corrosive attack, discouraging pitting. They also help to anchor the initial protective film, which shields the underlying metal.

Byers Wrought Iron is available now, in any quantity, for any project. You'll find some helpful information on its performance in our bulletin, "Byers Wrought Iron for Piping Services." May we send you a copy?

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ENGINEERING NEWS-RECORD

Devoted to Buildings, Sewerage, Waterworks, Bridges, Roads, Dams, Foundations, Earthwork, Flood Control, Public Works, Airports, Irrigation, Canals, Tunnels, Railroads

Volume 136 • Number 8

FEBRUARY 21, 1946

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WALDO G. BOWMAN ..... *Editor*

EDWARD J. CLEARY ..... *Executive Editor*

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Here's Key

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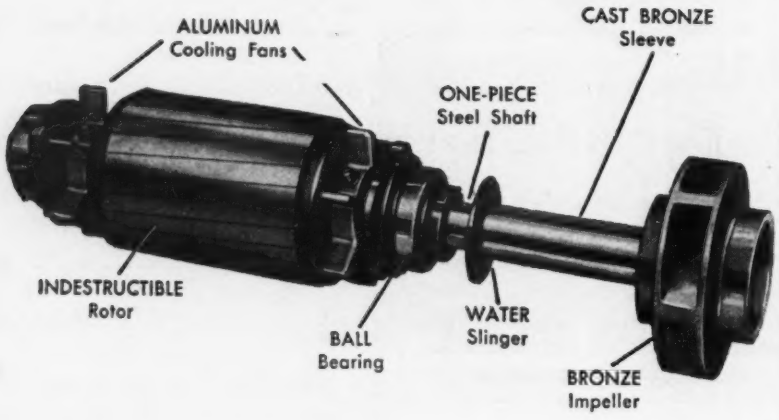
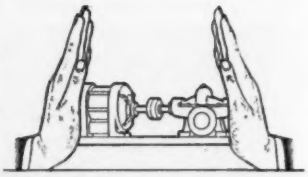


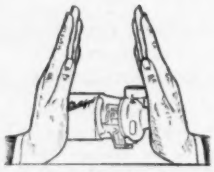
NEW KIND of pumping power now gives you new standards of performance and economy! Allis-Chalmers engineering has combined pump and motor into a single, compact unit—the "Electrifugal" Pump—which takes less space, gives you smooth operation with maximum protection against dangers of abnormal wear, leakage, corrosion, vibration! One-piece iron casting forms motor yoke, bearing housing, pump bracket and feet. One shaft running on 2 ball bearings carries the motor-rotor and pump impeller (see above). Result: true alignment, smooth operation—less maintenance! For you that means extra strength, extra value in terms of operating economy and long life. For complete information about this great pump, call our nearest office, or write ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

HEAR THE BOSTON SYMPHONY: *Saturday, American Broadcasting Co.*

A 1933



PROBLEM: Here is conventional pump and motor. How can we couple them together *better*—to save space, increase stability, and provide rigid alignment.



SOLUTION: We design a new kind of pumping unit—the one and only "Electrifugal" Pump! Motor and pump are now on one shaft—which cuts space 33%, assures alignment and smooth operation. No wonder "Electrifugals" give you more pumping power for your money!

SEA-BLUE BEAUTY: Modern design of Electrifugal Pump looks well on jobs anywhere! Capacities from 15 to 1600 gpm—heads up to 500 feet.

ALLIS-CHALMERS *Electrifugal* PUMPS

Proposed Engineering Construction Backlog and Volume Per Capita

Engineering construction backlog increases 3 percent over previous month, now at $28,868,917,000, $219 per capita. Backlog for Middle Atlantic states, $7,205,378,000, high region; earthwork and drainage proposed backlog, $6,947,682,000 leads other eight classes.

The cumulative proposed construction backlog measured from January 1943 through January 1946 is $28,868,917,000. During January, $866,995,000 was added; a 3 percent increase over the December 1945 cumulative total.

RECORD OF PROPOSED CONSTRUCTION BACKLOG INCREASES

	Backlog	% Gains over Previous Year	Total
Sept. '43..	$3,476,987,000	....	....
Dec. '43..	5,101,087,000	....	+47
June '44..	11,422,839,000	....	+124
Dec. '44..	16,615,028,000	+226	+60
June '45..	21,439,008,000	....	+29
Dec. '45..	28,001,922,000	+69	+31

Geographically, the Middle Atlantic states lead with $7,205,378,000, 25 percent of the nation's total. Percentages of the total for the other sections are as follows: West of the Mississippi, 23 percent; Far West, 20 percent; Middle West, 18 percent; and New England, 5 percent.

The proposed backlog of public construction, $24,423,770,000 is 85 percent of the total for the United States with the $4,445,147,000 private construction backlog making up the remaining 15 percent.

Earthworks lead

Earthwork, irrigation and drainage, with $6,947,682,000 leads other classes of engineering construction with 25 percent of the total backlog. The other classifications follow in order with: public buildings, 21 percent; unclassified, 17 percent; highways, 13 percent; commercial buildings, 7 percent; sewerage, 5 percent; industrial buildings, 5 percent; bridges, 4 percent and waterworks, 3 percent.

Proposed engineering construction volume per capita for the United States, using the 1940 census, is $219. The Far Western states with a per capita construction backlog of $522, top all other regions. States West of the Mississippi are second with $248 and Middle Atlantic states third with $238. Middle Western states, $193, are fourth; New England, $164, fifth; and Southern states trail with $91 per capita proposed for future heavy construction.

Arizona highest per capita

Of the individual states, Arizona leads with a per capita volume of $1,290; Nevada, with $1,056; and Wyoming with $939, are close behind. The relative low population of the above states coupled with large amounts of proposed reclamation projects scheduled for them by the federal government explain why they are so far ahead of the national and regional per capita volumes. States with the lowest per capita construction backlog are grouped in the South with Kentucky, $32, low; and Mississippi, $52, and Alabama, $56, slightly above. In all, 21 states equal or exceed the national per capita volume.

Among the other leading states are Montana, $809; Washington, $686; District of Columbia, $597; Idaho, $515; Oregon, $495; South Dakota, $462; Utah, $447; California, $428; North Dakota, $391; Colorado, $386 and Texas with $350 per capita.

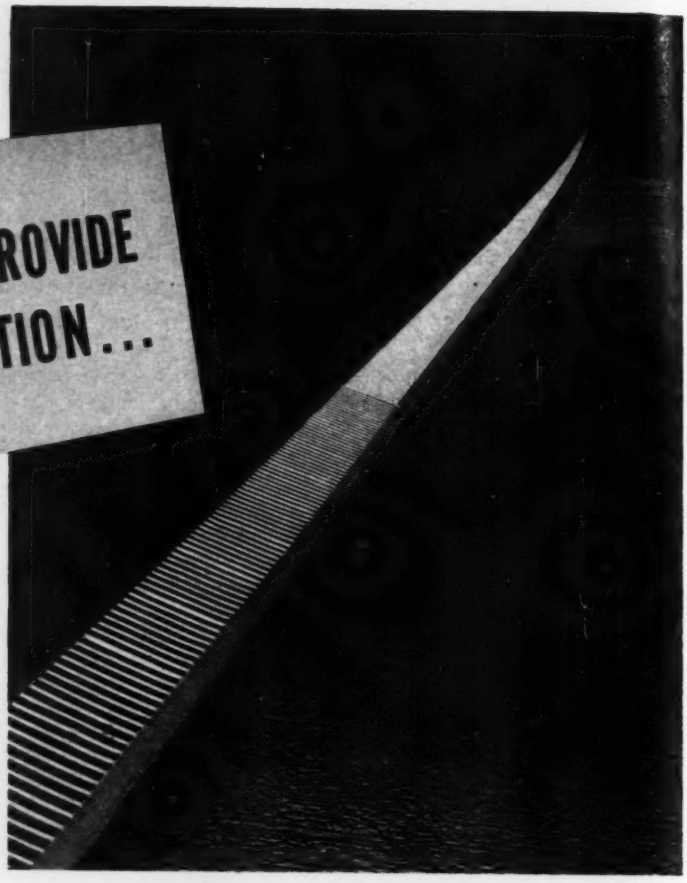
ENR MEASURED BACKLOG OF PROPOSED CONSTRUCTION

Class of Work	Backlog	% of total
Waterworks	$891,452	3
Sewerage	1,578,028	5
Bridges	1,154,757	4
Earthwork—Drainage	6,947,682	25
Streets—Roads	3,800,600	13
Public Buildings	6,044,543	21
Industrial Buildings	1,480,115	5
Commercial Buildings	2,057,686	7
Unclassified	4,914,054	17
TOTAL JAN. 31, 1946	$28,868,917	100

Proposed Engineering Construction Backlog Per Capita

	Population 1940 census (Thousands)	Total Proposed Volume	Volume $ Per Capita
Maine	847	91,784	108
New Hampshire	492	77,864	158
Vermont	359	85,763	239
Massachusetts	4,317	570,706	132
Rhode Island	713	104,368	147
Connecticut	1,709	454,497	266
New England	8,437	1,384,982	164
New York	13,479	4,102,576	304
New Jersey	4,160	674,812	162
Pennsylvania	9,900	1,501,386	152
Maryland	1,821	492,548	270
Dist. of Columbia	663	395,851	597
Delaware	267	38,206	143
Middle Atlantic	30,290	7,205,378	238
Virginia	2,678	374,274	140
West Virginia	1,902	106,547	56
North Carolina	3,572	371,561	104
South Carolina	1,900	212,765	112
Georgia	3,124	203,200	65
Florida	1,897	323,346	170
Alabama	2,833	157,383	56
Mississippi	2,184	114,331	52
Louisiana	2,364	336,496	142
Kentucky	2,846	91,925	32
Tennessee	2,916	277,173	95
South	28,216	2,569,001	91
Ohio	6,908	1,405,335	203
Indiana	3,428	463,039	135
Illinois	7,897	1,642,405	208
Wisconsin	3,138	277,128	88
Michigan	5,256	1,354,616	258
Middle West	26,627	5,142,523	193
Minnesota	2,792	279,116	100
Iowa	2,538	122,240	48
Missouri	3,785	974,911	258
Arkansas	1,949	150,177	77
North Dakota	642	251,339	391
South Dakota	643	297,360	462
Nebraska	1,316	277,621	211
Kansas	1,801	318,004	177
Oklahoma	2,336	422,925	181
Texas	6,415	2,245,910	350
Montana	559	452,106	809
Wyoming	251	235,699	939
Colorado	1,123	433,392	386
New Mexico	532	145,716	274
West of Miss.	26,682	6,606,516	248
Idaho	525	270,324	515
Utah	550	245,985	447
Arizona	499	643,765	1,290
Nevada	110	115,119	1,056
Washington	1,736	1,191,288	686
Oregon	1 090	540,092	495
California	6,907	2,952,944	428
Far West	11,417	5,960,517	522
United States	131,679	28,868,917	219
Canada	11,420	4,246,705	327

WHEN HEADLAMPS PROVIDE THE ONLY ILLUMINATION...



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White Concrete Reflecting Curb

made with

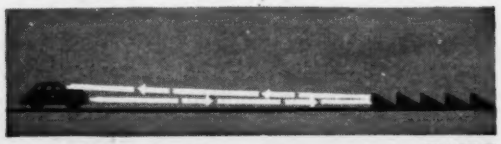
Atlas White Cement

This scientifically designed curb greatly increases the value of car headlamps. The projecting saw-tooth faces of the curb catch the lamp rays and reflect them back to the driver. They create a bright ribbon of reflected light that clearly defines the edge of the road.

White Concrete reflecting curb made with Atlas White cement may be built into any road . . . old or new.

Write for details. Send for booklet.

A smooth curb (above) wastes the car's headlights. It reflects them away from the driver. A White Concrete Reflecting Curb (below) conserves this light. It reflects the headlights back to the driver. Thus a smooth curb is barely visible at night, while a White Concrete Reflecting Curb stands out—bright and clear. Write for details.



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SUNDAY EVENINGS—*American Broadcasting Company (Blue) Network—U. S. Steel's "The Theatre Guild on the Air"*

News of the Week

ENGINEERING NEWS-RECORD • FEBRUARY 21, 1946 • VOLUME 136 • NUMBER 8

Large new hospital program planned for war veterans

Army Engineers will share in supervision of the construction of 80 hospitals to cost $448 million—Work to be done by contract under the division engineers

The Veterans Administration Feb. 16 announced the start of a great hospital building program, to provide war veterans with a total of 80 new, permanent hospitals in 39 states, at a cost of $448,000,000.

Gen. Omar N. Bradley, Veterans Administrator, said that Army Engineers have been assigned a large part of the program—for which completion date is set in 18 months to two years. The hospital work which cannot now be handled by VA-employed engineers will be carried on by the U. S. Engineer Department.

Additionally, VA will retain the engineers and designers now employed by it, to continue some hospital projects which are already under way. There is also the possibility, Gen. Bradley said, that this staff will take on more work at a later date.

Asked by *Engineering News-Record* for a statement on Army Engineers participation in General Bradley's proposed hospital program for the Veterans Administration, Lt. Gen. Raymond A. Wheeler, Chief of Engineers, said: "The Secretary of War has authorized the Corps of Engineers to construct such hospitals as may be requested by General Omar A. Bradley of the Veterans Administration upon designation by the Veterans Administration of the site and the type of hospital required in any locality. The Corps of Engineers through its field organization will select an architect-engineer to design the hospital and will contract for its erection under Army Engineer supervision."

Detailing the program, General Bradley said that the program to add 151,500 beds to the present capacity of 83,339 in the existing 98 veterans' hospitals is expected to meet needs up to 1948.

In commenting on the plans, General Bradley said that wherever possible, tall buildings will be constructed, rather than the sprawling structures built in earlier years. These new hospitals will be built near medical centers when this is possible. The administrator said he saw no conflict with the civilian housing program.

Cost of 1,000-bed hospitals will be about $10,000,000. Costs of smaller units will approximate: "Medium-sized" institutions, $6,000,000; smaller units, from $2,500,000 to $5,000,000.

Architects engaged to date to prepare plans include: Addison Erdman, of Butler, Kohn and Erdman, New York City; Slocum Kingsbury, of Franklin, Kingsbury and Stenhouse, Washington, D. C., and Carl A. Erickson, of Chicago.

Bids in on Chicago sewer, low figure is $666,800

Six bids were received Feb. 14, by the Sanitary District of Chicago for the construction, in tunnel, of 11,800 ft. of 4½ x 5-ft. reinforced concrete sewer, complete with appurtenances. The Santucci Construction Co., Skokie, Ill., submitted the low bid of $660,800, which agreed reasonably close with the engineers' estimate. John C. Tully of Chicago was second with a bid of $681,800, and Paschen Contractors, Chicago, were third with a bid of $704,500.

When completed, this new sanitary sewer will serve a 5½-sq. mi. area located northwest of Chicago. It will include part of the suburban towns of Wilmette and Glenview, Ill., and a new residential development project of Northwestern University. Present plans are for the sewer to connect with the sanitary district's pumping station at Golf Road and the North Branch of the Chicago River. Ultimately it will form a part of the Howard Street interceptor which is a part of the Northside Treatment Works.

Press Assn. photo

Largest bull ring takes shape in Mexico

Said to be the largest bull ring in the world this great arena was opened in Mexico City, Mexico, Feb. 5.

Planned to seat 47,000 persons, it is the first unit of a giant sports center now under construction in the heart of the Mexican capital (ENR, Nov. 8, 1945, vol. p. 632), which will also contain a football stadium, swimming pools and other facilities.

Sandbags, each weighing 310 lb., were placed in seats on the upper tier as a test load, prior to the opening.

NEWS IN BRIEF

In telegraphic form, here are latest news developments on the engineering and construction front during the week.

Highways—The *Mexican* government authorized a $32,000,000 bond issue to finance highway construction. . . . *Arkansas'* governor appointed a 34-member committee to study means of providing adequate county and state roads. . . . *Minneapolis, Minn.*, announced plans to build or replace 500,000 linear feet of sidewalks. . . . *Texas* said it had awarded $16,000,000 worth of road construction contracts since V-J Day. . . . *Columbia, S. C.*, planned a $200,000 street paving program. . . . Seeking means of easing downtown traffic jams, *Kansas City, Mo.*, and *San Francisco, Calif.*, planned garages under city parks.

Bond Issues—*Rockford, Ill.*, will vote April 9 on a $1,000,000 bond issue for extension of sewer service. . . . *McAlester, Okla.* will vote on a $1,328,000 issue for general improvements. . . . *Lakewood, Ohio*, voters will decide in May on a $1,800,000 issue for school construction. . . . *Johnson County, Kan.*, just outside *Kansas City, Mo.*, will vote March 12 on a $1,300,000 issue sanitary sewers.

Water Supply—*Rochester, N. Y.*, received $43,000 from the state planning commission to defray engineering cost on a proposed enlargement of the city water supply. . . . *Savannah, Ga.*, approved a $3,760,000 fund for construction of a new water plant and extensions to the supply system.

Building—*Syracuse, N. Y.*, will build a $2,000,000 war memorial. . . . Apartment houses to cost $100,000 are planned at *Jackson, Miss.* . . . Harvard University will build a $1,500,000 underground library at its *Cambridge, Mass.*, campus. . . . Catholic high schools to cost $10,000,000 will be built in the Diocese of *Buffalo, N. Y.* . . . Char-Dale Mfg. Co. will spend $500,000 on new construction at *Minneapolis, Minn.* . . . *Santa Barbara, Calif.*, plans to spend $644,000 for county buildings. . . . U. S. Rubber Co. will spend $500,000 for a new office at *Kansas City, Mo.* . . . Western Illinois State Teachers College will spend $2,540,000 for new buildings at *Macomb, Ill.*

Sewage Disposal—The *Pennsylvania* State Sanitary Board extended to July 1 the time for the City of *York* to file plans for improvements to its sewage treatment plant. . . . FWA approved funds for planning a $1,472,000 sewer system and disposal plant at *St. Matthews, Ky.*

Miscellany—Mayor M. L. Reichert called for an $11,000,000 civic improvement program for *Evansville, Ind.* . . . *Pittsburgh, Pa.*, will build a 13½-acre recreation center. . . . *Alton, Ill.*, and other communities purchased a 120-acre site for a memorial airport. . . . *Atlanta, Ga.*, considered a proposal to construct a $1,000,000 stadium as a war memorial.

Adm. C. H. Cotter named to material division post

Rear Adm. Carl Henry Cotter, formerly commander of all operations in the Pacific for the Bureau of Yards and Docks, on Feb. 8 was named as vice chief, Material Division, to assist his former Civil Engineer Corps chief, Adm. Ben Moreell.

Rear Adm. C. H. Cotter

A native of Bay City, Mich., Admiral Cotter entered the Navy as a lieutenant, j.g., in the Civil Engineer Corps in January, 1918.

The coming of the second world war found him public works officer of the Fifth Naval District, at Norfolk, Va., a post he held until April, 1942. At that time he became superintendent of civil engineering in an area covering North and South Carolina, Virginia and West Virginia, Maryland and the District of Columbia. From February, 1943, until June, 1945, he was director of the Pacific Division for the Bureau of Yards and Docks, with the added duty (as of February, 1945) of deputy commander of naval construction battalions and ancillary units in the Pacific Ocean areas.

Calendar of Meetings

NATIONAL

American Society for Testing Materials, spring meeting, Hotel William Penn, Pittsburgh, Pa., Feb. 26-27.

American Society for Testing Materials, committee week, Hotel William Penn, Pittsburgh, Pa., Feb. 25-March 1.

National Society of Professional Engineers, conference of state presidents of member state societies, and board of directors meeting, Deshler-Wallick Hotel, Columbus, Ohio, March 29-30.

REGIONAL

Minnesota Federation of Engineering Societies, victory convention, Hotel Radisson, Minneapolis, Minn., Feb. 21-23.

Wyoming Engineering Society, annual meeting, USO Building and Plains Hotel, Cheyenne, Wyo., Feb. 22-23.

Ontario Good Roads Association, annual convention, Royal York Hotel, Toronto, Ont., Feb. 26-27.

Ontario Roadbuilding Association, annual convention, Royal York Hotel, Toronto, Ont., Feb. 27.

Michigan Highway Engineering Conference, Grand Rapids, Feb. 26-28.

Pacific Southwest Section, Society for the Promotion of Engineering Education, annual meeting, Berkeley Campus, University of California, Feb. 22-23.

Kansas Highway Engineering Conference, annual meeting, Kansas State College, Manhattan, Kansas, Feb. 28-March 1.

Southern Safety Conference, 7th annual meeting, Winston-Salem, N. C., March 3-5.

Minnesota Section, American Water Works Association, Radisson Hotel, Minneapolis, Minn., March 14-15.

New Jersey Society of Professional Engineers, 1946 convention, Essex House, Newark, N. J., March 15-16.

Mississippi Valley Conference of State Highway Departments, annual meeting, Edgewater Beach Hotel, Chicago, Ill., March 15-16.

New England Section, American Water Works Association, Statler Hotel, Boston, Mass., March 21.

Correction

In the "Major Projects" section of *ENR* Feb. 7, vol. p. 229, the Johns-Manville research center was listed as the first unit of a $40,000,000 research center. The research center, actually, is only the first unit of a $40,000,000 general expansion program planned by the company.

AGC offers aid in housing program, hears army plans more work by contract

Organization pledges cooperation with new housing program—Hears Gen. Wheeler discuss contract system for flood control work

The Associated General Contractors of America will cooperate fully with the federal government in providing information as to locations where housing is most needed, the organization pledged this week. Such information was said to be a vital first step in mobilizing the construction industry to carry out a program for starting 2,700,000 new dwellings by the end of 1947.

This recommendation was made by H. A. Dick, AGC president, in a letter to President Truman dated Feb. 12, but released in Chicago Feb. 18—the opening day of the association's 27th annual convention.

The letter pledged cooperation in working toward the objectives of the veterans' emergency housing program (*ENR* Feb. 14, vol. p. 257), and emphasized the duty of the construction industry to fulfill all of the nation's construction needs. These needs include: Utility and community facilities to serve new housing; and industrial, commercial and transportation improvements to maintain a high level of employment and income, the letter brought out.

Said Mr. Dick: ". . . Mr. Wilson W. Wyatt . . . has outlined a series of bold steps which project the Federal Government into the solution of a peacetime problem to practically the same extent that the government directed our national energies for wartime purposes. This association hopes that it is your intent, and his, to relax government regulations and restrictions as quickly as you think that becomes possible.

"Because practically every form of progress of this nation requires some form of construction, this association on behalf of its members offers its assistance to the government in the difficult phase of administration, so that the nation is not in the position of having all of its construction eggs in the housing basket."

Referring to the proposal to postpone all deferrable and non-essential construction in 1946, Mr. Dick stated ". . . Our governing and advisory boards last November recommended that, so long as labor and materials are scarce, contractors in their respective communities use their knowledge of construction to counsel with local groups to seek the start of new projects in order of their need so that those projects most urgently needed in the community could be undertaken first."

"The administration of a program which seeks to direct the nation's construction effort toward one goal is complex and difficult. . . . The association offers to the government its knowledge of the construction industry . . . for assistance in the program of providing housing for veterans."

Engineer work by contract

More emphasis is being placed on the contract system for performing U. S. Engineer flood control work and navigation improvements, said Lt. Gen. Raymond A. Wheeler, chief of engineers, in addressing the convention.

"Our plans and designs are so drawn as to facilitate letting contracts for their execution wherever possible," he said, "and we welcome the participation of well-qualified contractors in carrying out those jobs to which we are assigned.

Out of the $125,000,000 provided in the 1946 Deficiency Bill, $84,659,000 has been earmarked for general flood control projects, Gen. Wheeler added. (*ENR*, Jan. 3, vol. p. 4). These funds will be applied to 116 individual projects in 33 states.

Fifty-three dams will be undertaken, of which 18 are to be concrete structures and 35 earth or rock fill. The remaining 63 projects consist chiefly of local protection levees and floodwalls, with some channel improvement.

"The Civil Functions Appropriations Bill for the fiscal year beginning July 1, 1946 has now passed the House with an additional $262,000,000 voted for rivers and harbors and flood control work under the supervision of the Corps of Engineers. The current flood control program can be expanded as rapidly as Congress may direct," said Gen. Wheeler. "There is at present a backlog of flood control projects which have been authorized but for which funds have not been appropriated, totaling just short of one billion dollars, representing more than 600 planned and authorized reservoir and local protection projects."

For the benefit of those contractors in need of construction equipment, Gen. Wheeler declared that the corps has reported to surplus disposal agencies as many items of its construction equipment and as much of its inventory of building materials as possible at this time without necessitating new procurement.

U. S. sanitary engineers visit Imhoffs in Germany

When a civilian specialist group from the United States, representing the Technical Industrial Intelligence Committee, visited Germany last fall to investigate what advances had been made in sanitation developments, a call was made on Dr. Karl Imhoff. This noted sanitary engineer, whose practice and patents have had favorable acceptance in the United States since about 1910, furnished information on what had transpired in Germany during the war years.

Dr. and Mrs. Imhoff are shown in the above photo with three of the TIIC specialists, who were: Arthur V. Sheridan, commissioner of public works, The Bronx, N. Y.; Anthony J. Fischer, development engineer of The Dorr Co., Inc., New York City; and Arthur E. Gorman, engineer - representative of the War Production Board, Washington, D. C. The picture was taken at Schondorf, near Munich in Bavaria, one of the least damaged areas in Germany, and present home of Dr. Imhoff.

For details on the committee's findings see ENR, Jan. 24, 1946, vol. p. 140.

Canada engineers see probable surplus in profession, fear loss to U.S.

Engineering Institute speakers note unusual number of men in schools now, lack of present opportunities in Canada—Drop examinations

Because Canada, unlike the United States, did not curtail engineering education during the war, the Dominion probably will have a surplus of civil engineers, and Canadian industry should look to means of retaining these men for work at home, speakers at the 60th annual meeting of the Engineering Institute of Canada said at Montreal Feb. 8.

The meeting, held Feb. 7-8, was the first full postwar session of the institute, and attracted more than 1,400 members, the largest attendance ever recorded.

J. B. Hayes, of Halifax, N. S., general manager of the Nova Scotia Light and Power Co., was inducted as president, succeeding E. P. Featherstonehaugh, dean of the University of Manitoba, Winnipeg.

Reporting on the activities of the organization under his leadership. Mr. Featherstonehaugh pointed out that engineering students in Canadian universities were granted deferments from military duty to complete their studies.

"In view of this fact, and of the large number of undergraduates now being trained . . . all engineers and employers should give very serious consideration to the . . . problem of retaining the training and skills of these young men for work in the development of the Dominion," he added.

Members of the engineering staffs of Canadian universities, holding a novel meeting of their own at the conclusion of the formal institute session, supported Dean Featherstonehaugh's conclusions with the statement that the schools now have a total registration far more than twice the highest number previously recorded—a typical increase being 4-fold at the University of Toronto.

Drop membership exams

The meeting passed amendments to the institute's by-laws that raises annual dues by five dollars for all members—the increased revenue to finance extension of activities.

At the same time, it was announced that the institute will drop membership examinations, instead accepting the corresponding examinations of the various provincial professional engineers' associations. These examinations are required by law.

British war engineering

British engineers in the early days of the war supervised immense amounts of emergency work, according to Percy Dunsheath, president of the Institution of Electrical Engineers of Great Britain. Mr. Dunsheath was one of several guests, including the secretaries of several American engineering societies, who emphasized the international aspect of the institute's meeting.

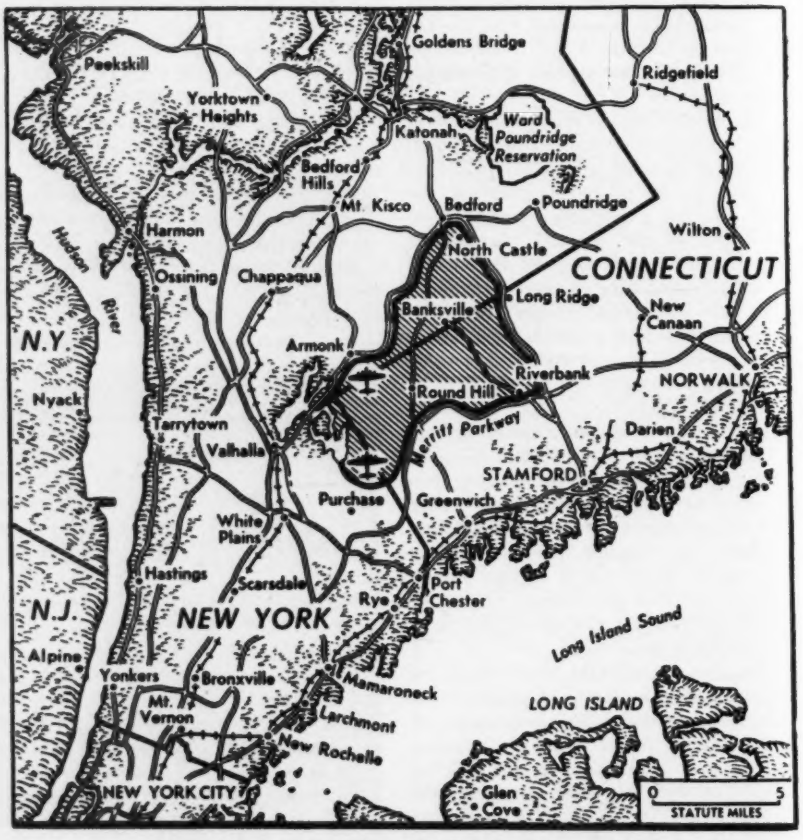
During the war—and particularly during the days of the "blitz"—Mr. Dunsheath said Britain spent more than $600,000,000 on airraid shelters; $75,000,000 on emergency water tanks, and fabricated more than a million tons of steel into shelters for individual families.

He said that a total engineer force of 30,000 men, sometimes reinforced by units of the Royal Engineers, was unable to keep pace with the air raid damage during the worst period of the raids on London. Wartime airfields built in England have runways equal to a 30-ft. roadways, 10,000 miles long.

Technical sessions

J. A. Van den Broek, professor of engineering mechanics, University of Michigan, presented the results of a long series of tests conducted on the properties of light metal alloys, as currently used in aircraft production. In general discussions on possibilities of these metals in

(*Continued on following page*)



Approved site for UNO world capital

This 42sq. mi. site, shaded, in Connecticut and Westchester County, N. Y., has been recommended as the site of the United Nations World Capital by a committee that concluded its surveys in the United States recently.

Announcement last week of approval of the site by the UNO assembly brought immediate and strenuous protest from the residents of the area, which includes several small communities and numerous large estates. Residents, foreseeing their eviction from their homes, and community governments, which saw loss of a large area of taxable property, held protest meetings, so far without results.

Engineer consultants who served the site-seeking committee of the UNO were: Walter Blucher, Planning Consultant and Director of the American Association of Planning Officials, Chicago; Russell Van Ness Black, New Hope, Pa.; Harold M. Lewis, New York.; Ernest P. Goodrich, New York, N. Y.; Arthur Comey, Cambridge, Mass.

Also, Frederick J. Adams, Massachusetts Institute of Technology; Joseph Leland and Roland Greeley, Boston, Mass.; and Justin Hartzog, Cambridge, Mass., consultant to the Rhode Island Planning Commission.

Supreme Court widens Wage Hour Law

Two recent decisions of the U. S. Supreme Court have increased appreciably the number of workers that will come under the Wage-Hour Law in force since 1938. Because of the scope of the decisions, higher costs may result for some classes of construction.

On Jan. 28 the court, in deciding the Roland Electrical Co. vs. Metcalfe Walling case, had to decide whether or not the employees of a Baltimore, Md., company, whose primary work consists of repair of electrical motors and other electrical equipment used and consumed by manufacturing companies only in the state of Maryland were engaged in commerce or in the production of goods for commerce; and if so, whether or not they are exempt from the wage and hour provisions of the act.

The court unanimously decided as follows; "although in this case the motors sold by the petitioner were not purchased by its customers for resale or to be processed for resale, and although they were to be used and probably ultimately to be consumed in the hands of the petitioner's customers, these motors remained actively in use in the production of the flow of goods for interstate commerce. It is to this great field of the production of goods for interstate commerce that the act is directed.".

Ruling on employees

The court also ruled ". . . this does not require the employee to be employed even in the production of an article which itself becomes the subject of commerce or transportation among the several states. It is enough that the employee be employed, for example, in an occupation which is necessary to production of a part of any other articles or subjects of commerce of any character' which are produced for trade, commerce or transportation among the several states. . . . There may be alternative occupations that could be substituted for it but it is enough that the one at issue is needed in such production and would, if omitted, handicap the production."

On Feb. 4 the court in ruling on the Martino V. Michigan Window Cleaning Co. case also decided that window washers working on a building that was used by a concern engaged in commerce were within the scope of the law.

Both decisions point to the danger that some employers may be subject to suits by employees to recover additional pay since 1938 or when the law was enacted. The decisions accentuate the importance of the pending Gwynne Bill (H. R. 2788) already favorably reported out by the House Judiciary Committee and establishing a 1-year statute of limitations affecting such suits and eliminating the more than 7-year retroactive liability to which the decisions threaten them.

Commission would finish Savage Dam

As result of a meeting Feb. 8 and 9 at Luray, Va., the Interstate Commission on the Potomac River Basin approved a program calling for early action to complete Savage River Dam 22 miles southwest of Cumberland, Md.

The commission declared the dam of vital importance in ending pollution on the upper Potomac and that it should be finished as soon as possible.

The 175-ft. high earthfill structure was begun in 1939 as a WPA project and much work had been done before the job was shut down in December, 1942, because of the war. The Upper Potomac River Commission has about $200,000 available for the remaining construction, which is expected to cost about $1,200,000. The dam will increase dry-weather flow in the river.

Small "aeration" dams proposed

Another outcome of the meeting was the decision to attempt to obtain funds for construction of a series of low overflow rockfill dams on the upper Potomac in the reach of the river between Luke and Pawpaw, W. Va. these dams will be 1 to 2 ft. high and similar to those built by the Indians for fishing purposes. The low dams are expected to be of special value because they would result in extensive aeration of the stream flow, yet could be constructed at reasonable cost with materials in the stream.

Virginia has already approved the four classes of water criteria to permit the basin to be divided into different zones to determine the necessary abatement measures for each zone, the conference was told. The other signatories of the compact—West Virginia, Maryland, Pennsylvania, and the District of Columbia—informally reported to the river commission that they will soon approve the minimum water quality classifications, which were tentatively adopted last August at a meeting which was held at Hershey, Pa. (*ENR* Aug. 16, 1945. vol. p. 203.)

Canadian Engineers

(*Continued from p. 56*)

civil engineering practice, one speaker criticized Mr. Van den Broek's use of structural rolled sections for testing light alloys and then comparing results with corresponding results for steel sections—suggesting that extruded hollow sections might more properly have been used.

K. P. Billner, president of the Vacuum Concrete Co., Philadelphia, Pa., described the application of his vacuum curing method for the manufacture of precast house units.

Great Lake waters in winter

One of the highlights of the meeting was the presentation of a paper on "The Winter Temperature Cycle of the St. Lawrence Waters—a Plea for More Data", by 84-year-old J. G. G. Kerry, of Port Hope, Ont.

Mr. Kerry presented a mass of data on the temperature of the waters of the Great Lakes during the winter. He cited the possibility that this great volume of water, which never cools to the freezing point, might provide a reservoir of heat which, if it could be tapped, might be used for improving navigation on the St. Lawrence during winter months.

M. Curzon, of the Montreal Engineering Co., said his company had made studies similar to those suggested by Mr. Kerry, and had actually used two of Mr. Kerry's ideas, on a small scale.

The elevation of the discharge sill from the Ghost River reservoir in Alberta was fixed well below the ice level, Mr. Curzon said, with the result that water which was discharged in midwinter was found to be at a temperature of 37 deg. F., even when it reached the discharge channel—thus preventing ice trouble.

Hayes has broad experience

Mr. Hayes, the new institute president, received his engineering degree from Nova Scotia Technical College in 1916, and served during the first world war with the Royal Canadian Engineers. His career since the end of that war has included service with Stone and Webster Corp., Boston, Mass.; the Fort Madison, Iowa, Electric Co.; the Virginia Electric and Power Co., and engineering work in the West Indies. He is a past-president of the Canadian Electrical Association, the Canadian Transit Association and the Halifax Board of Trade.

J. B. Hayes

City seeks army camp as material source

San Diego's move may set pattern for reconversion of military bases

A pattern for the reconversion of military installations throughout the country into private use is now being worked out on a "trial and error" basis in San Diego, Calif., where the city is negotiating with the federal government for the purchase of the Army's Camp Callan. At the urging of Mayor Harley A. Knox, the city late in January sent telegrams to Washington in an attempt to obtain possession of the now vacant buildings as a source of material for badly-needed homes. The city proposed to dismantle the buildings and sell the material to individual builders and private contractors who will promise to build homes.

San Diego's claim to the buildings lies in the fact that Camp Callan is located on 700 acres of "pueblo," or city owned land, and has been leased to the government for a dollar a year.

The 650 buildings on the site, including 154 two-story barracks, contain about 1,650,000 sq. ft. of floor space. City officials estimate that over 30,000,000 bd. ft. of lumber would be made available by the salvage. Interiors will yield a considerable amount of knotty pine.

In addition, the salvage would produce large quantities of wiring, gas and water mains, scarce plumbing equipment, and other materials that might make possible the erection of 2,500 homes. Two alternatives will be offered to the city: either the opportunity to purchase the property outright and keep what profits may accrue, or to put up a cash guarantee and act as sales agent for the government, with the profits going into the federal treasury.

In either case, the smaller buildings would be sold outright to individuals capable of dismantling them, while the larger buildings would be dismantled under a private contract, and the salvaged material sold to individuals and private contractors agreeing to build homes. Proceeds of the sale would pay for the dismantling and administration costs.

Illinois gets barracks

Struggling with the problem of providing accommodations for veterans at its schools and in cities, several Illinois communities recently reported the acquisition of Army camps for housing.

Empty barracks at the Army Air Forces Chanute Field at Rantoul, Ill., will be turned over to the University of Illinois to house 2,000 students. The five Illinois State Teachers Colleges reported to the state authorities that they will require housing facilities for 4,580 men and women, and 625 married couples.

Court directs Hyperion chlorination

A decision by Superior Judge Joseph W. Vickers in California's suit against Los Angeles and nine other communities in that area for abatement of sewage polution of beaches, sets June 1 for completion of the installation of chlorination equipment.

The decision establishes a deadline for the installation, previously recommended by the court, as a temporary solution to the problem. Testimony at the trial of the state's case against the ten defendant cities and districts (*ENR*, Jan. 31, vol. p. 155, and previously) said that a faulty outfall sewer emptying into the ocean at Hyperion contaminated beaches from Manhattan Beach on the south to Venice, Calif., on the north—a distance of 3½ miles. Chlorination was recommended by sanitation engineers as a stopgap solution that would correct the contamination conditions until a new $21,000,000 treatment plant and outfall can be built.

The decision ordered that the new plant be completed by Dec. 31, 1947, and that the remainder of 10 miles of quarantined ocean frontage be free of sewage contamination by that date. The judgment "permanently enjoins" the defendant cities from discharging into the salt waters of Santa Monica Bay "any sewage or sewage effluent or any material or substances which are offensive, injurious or dangerous to the public health on and after the first day of August, 1947, except through a non-leaking submarine tube extending from the present mean high tide line into the Pacific Ocean at least 5,000 ft."

Municipalities against which the decision was rendered are: Los Angeles, Beverly Hills, Alhambra, Burbank, Culver City, El Segundo, Glendale, Santa Monica, South Pasadena and Vernon.

City votes $4,000,000

Approval of a $4,000,000 bond issue was given by voters of Sanitation District 3, Los Angeles County, Feb. 5, to supply funds for construction of trunk sewers and other work within the district, buy an interest in a joint treatment plant and outfall sewer at White Point, and for expansion of facilities at the plant.

Authorized were expenditure of $2,908,000 for sewer construction in the district, which includes most of Long Beach, Lakewood Village, and an area south of Bellflower, Calif.; $735,000 for the 25 percent interest in the plant, owned by the Metropolitan Sewage District, and $357,000 to cover District 3's share of improvements to be made in the treatment plant works.

The district has been in existence for several years but had not as yet used the facilities of the Metropolitan Sewage District.

Nominate Col.H.A.Byroade as brigadier general

Nomination of Col. Henry A. Byroade, 32, for promotion to the temporary rank of brigadier general was approved by President Truman recently.

Col. H. A. Byroade

Colonel Byroade is now military attache to China and as such, assistant to General of the Army George C. Marshall, who is now Ambassador to China.

A native of Maumee Township, Ind., Colonel Byroade was graduated from West Point in June, 1937, and received his engineering degree from Cornell University, Ithaca, N. Y., in 1940.

Holder of the Legion of Merit, Colonel Byroade served with distinction in the China-Burma-India Theater during the war period just past.

Gen. Robins, consultant for Portland, Ore., port

Maj. Gen. Thomas M. Robins, on terminal leave after serving as deputy chief of staff of the U. S. Army Engineers, has been engaged by the Port of Portland, Ore., Commission as consulting engineer to assist in industrial and port development.

An engineer officer since his graduation from West Point in 1904, General Robins served in Cuba with the Army of Cuban Occupation and in 1912 did engineering work on the harbor defenses of Manila. During the first world war he was engineer officer of the Port of Embarkation, Hoboken, N. J.

After graduation from the Army War College in 1926, he served in the office of the Chief of Engineers at Washington, and in November, 1929, became South Pacific Division Engineer at San Francisco. He later became Pacific Division Engineer (1934) and North Pacific Division Engineer (1937), at Portland, Ore. During his tenure at Portland, the Bonneville Dam was designed and built.

Army building supplies arriving from Pacific

Twenty-three ships with cargoes of building materials, heavy construction equipment, and other needed civilian goods have been ordered by the War Department to return from Pacific ports to the United States, the Senate National Defense Investigating Committee was told Feb. 13. The civilian items will be declared "surplus" for disposal to the public.

Two of the ships are loaded with 7,400,000 bd. ft. of lumber; eleven carry cargoes of other construction materials and equipment such as rollers, graders, compressors and paint sprayers.

In the cargoes, Senator Mead of New York, committee chairman, added, are 677 pre-fabricated huts and about 2,000 crates of barracks and buildings which could be used for temporary civilian housing, while other items include 5,830 rolls of asphalt roofing paper, 256,853 pounds of felt asphalt, such construction hardware as screening, pipe fittings, bathroom fixtures, and some unfinished lumber and office supplies and equipment.

Grant $1-a-day increase to Cleveland workers

A flat increase in wages of $1 per day for members of 14 of the 19 A.F.L. building trades unions in the Cleveland, Ohio, area has been agreed upon and forwarded to the Wage Adjustment Board at Washington for approval.

The increases are somewhat in line with similar pay scale rises now being approved in most sections of the United States. (*ENR*, Jan. 31, vol. p. 149)

Participating in the negotiations were representatives of the Cleveland Building Trades Council and the Cleveland Building Trades Employers' Association. Agreement was not reached with five crafts — the carpenters, bricklayers, plumbers, steamfitters and composition roofers.

In the event that approval is granted, the wage increase proposal will bring the average rate for Cleveland building craftsmen to $2 per hour. Under the present wage scale craftsmen receive between $1.75 and $1.87 per hour, making the $1 per day wage boost equivalent to approximately 15 percent. Builders said that adoption of the new wage scale would end "pirating" in the construction field in the area—a condition which has caused much debate during the last several months.

Gen. M. C. Tyler to advise Memphis on river harbor

As a further step in the plan to create a large sheltered harbor on the Mississippi River at Memphis, Tenn., Maj. Gen. Max C. Tyler, who recently retired as president of the Mississippi River Commission, has been engaged as technical advisor to the city of Memphis and Shelby County.

The major phase of that plan is the development of Tennessee Chute by damming the upper end and constructing protective levees on President's Island to make a better harbor for Memphis—an improvement first suggested by General Tyler last fall. Study of the project by Army Engineers was requested by the Senate Commerce Committee and a directive based on the request was issued to the River Commission by Lieut. Gen. Raymond A. Wheeler, Chief of Engineers. Maj. Gen. Robert W. Crawford is the new president of the commission (*ENR*, Sept. 13, 1945, vol. p. 337).

Gen. Tyler, after serving two terms on the Board of Engineers for Rivers and Harbors and a period in charge of the rivers and harbors section in the Office of the Chief of Engineers, he was made president of the Mississippi River Commission from which he retired at the end of last year. He was the author of the flood control plan on which Congress has authorized an expenditure of $200,000,000. He is now completing terminal leave after 43 years service.

County forces may build federal-aid projects

Although experience has demonstrated the economy and efficiency of the contract method of construction for highway projects, the Public Roads Administration will approve the construction of federal-aid projects by county forces on certain classes of secondary roads, if the character of the work or circumstances surrounding the project make it unsuitable for the contract method, according to an announcement by Commissioner Thomas H. MacDonald.

Construction by county forces will not be approved, the commissioner said, where it would be necessary for the county to purchase construction equipment not normally required.

The work to be performed, the manner of construction, the estimated cost and any other conditions should be clearly stated in an agreement between the state highway department and the county, he continued. A copy of this agreement will be made a part of the plans, specifications and estimates.

Federal reimbursement to the state will be based on the quantities of work performed, computed at the unit prices shown in the state's agreement with the counties. The agreed unit prices, Commissioner MacDonald said, should not exceed prices on comparable contract work. Use of county equipment will not be considered as a partial contribution in lieu of funds to match federal funds.

Plan $7.5 million all-air conditioned office building

One of the first completely air-conditioned office buildings in New York City will be erected shortly by the Tishman Realty & Construction Co., on a 90 x 200-ft. site on Park Avenue. The building will rise to a height of 21 stories, and contain about 270,000 net sq. ft. of office space above the street floor. The demolition of existing buildings will begin shortly, with completion of the new structure scheduled for May, 1947. Plans for the $7,500,000 structure have been prepared by Eli Jacques Kahn and Robert Allan Jacobs.

Six Cleveland railroad spans to be replaced

A large program for improving the inner harbor of Cleveland, Ohio, involving the replacement of 6 narrow railroad bridges and rebuilding another over the Cuyahoga River at a cost of $13,236,000, has been approved by the War Department it was announced last week by Herbert P. Ladds, president of the Cleveland Chamber of Commerce.

The work is to be financed by the federal government and the railroad companies concerned. It will be the first major project of its kind under the Truman-Hobbs legislation enacted by Congress 5 years ago to permit the government to participate in the financing of railroad bridge repairs or replacement when there is a hindrance to navigation.

Lieut. Gen. R. A. Wheeler, the War Department's Chief of Engineers, has recommended the Cleveland bridge program and apportionment of expenses—to which the railroads already had agreed—in reports to the Senate committee on commerce and the House rivers and harbor committee, according to Ladds.

The bridges to be replaced are:

New York Central near the harbor entrance

Baltimore & Ohio just above the Superior Viaduct point.

Two N. Y. C. (Big Four) spans next downstream from the city's wide new Carter Road vehicular bridge.

Big Four just south of the Lorain-Central Viaduct.

Wheeling & Lake Erie at Clark Avenue S. W.

The program also calls for replacement of the east pier of the Erie Railroad bridge at Mahoning Avenue S. W., or just below the Jefferson Avenue vehicular bridge. Work is expected to be started soon on removal by the city of the obsolete lowerlevel Main Avenue vehicular bridge.

West Coast firms fined for trust law violation

Fines ranging between $750 and $7,000 were imposed on six Pacific Coast culvert manufacturing companies and seven of their officers in a Seattle, Wash., U. S. District Court.

The defendants had pleaded nolo contendere to charges of violating federal anti-trust laws in the fabrication, sale and distribution of metal culverts.

In addition to fines totaling $4,000 each, E. W. Gibson, vice-president of the Oregon Culvert & Pipe Co. of Portland, and H. W. Force, president of the California Corrugated Culvert Co., of Berkeley, were sentenced to serve four months in jail, but sentences were suspended and probation periods of fifteen months imposed also by Federal Judgle Lloyd L. Black.

Companies named in the action, in addition to the two mentioned above, were Hydraulic Supply Manufacturing Co., Seattle; Collins Concrete & Steel Pipe Co., Portland; Beall Pipe & Tank Corp., Portland; Washington Culvert & Pipe Co., Seattle.

Wandering spillway gate comes home at last

A drum gate, 100 ft. long and 18 ft. in diameter, found its way home last month after having changed ownership three times in the last three years.

Originally designed and built by the Bureau of Reclamation for installation at the Friant Dam spillway in California's Central Valley project, the gate was sold to the army when work on Friant was postponed by the war. The gate was taken to Salinas Dam, a structure built to furnish water for Camp San Luis Obispo. Salinas Dam itself was started by the Quartermaster Corps and finished by the Corps of Engineers.

With the war's end, the capacity of Salinas Dam was found sufficient without the use of the gate. The gate was declared Army surplus and resold to the Bureau.

Col. Burton named realty director for Engineers

Col. Albert H. Burton, formerly division engineer, North Atlantic Division, U. S. Army Engineers, has been named director of real estate, Office of the Chief of Engineers, succeeding Brig. Gen. John J. O'Brien, who becomes Deputy Administrator of the War Assets Administration.

Colonel Burton, a 1925 graduate of the U. S. Military Academy, was appointed to the Construction Division,

Gen. O'Brien

Col. Burton

Office of the Chief of Engineers, in October, 1940. In May, 1943, he became district engineer at the Philadelphia, Pa., District Engineer Office. In January, 1944, he reported to the North Atlantic Division, New York City, as division engineer and engineer, Second Service Command, New York. Recently he received the Distinguished Service Medal for his work with the North Atlantic Division and Second Service Command.

JOBS OF THE WEEK

TUNNEL SHAFT, New York City

New York Tunnel Authority, New York, N. Y., received the lowest bid for Governor's Island shaft, Brooklyn-Battery Tunnel, from Grow Construction Co., New York, N. Y., at $3,629,230.

MENTAL INFIRMARY, Windsor, Ont.

Dominion Government, Ottawa, Ont., awarded a contract for a mental infirmary at Westminister hospital to Sterling Construction Co., Ltd., Windsor, Ont. The estimated cost is $1,625,000. Department of Public Works, Ottawa, is the engineer.

HANGAR and MAINTENANCE BUILDING, Los Angeles, Calif.

Western Airlines, Inc., Los Angeles, has awarded a contract for a steel, concrete, and stucco hangar and maintenance building to The Austin Co., Los Angeles, at $1,250,000. A. E. Schmidt, Los Angeles, is the engineer.

APPAREL CENTER, San Francisco, Calif.

Apparel City Corp., San Francisco, awarded a contract for an apparel center, including 1, 4, and 6-story buildings, to Harmey, Haas and Rothschild and to Barrett & Hilp, San Francisco, at about $1,000,000. J. Francis Ward and J. S. Bolles, are the architects.

DWELLINGS, Lakewood Village, Calif.

Paul W. Trousdale, Los Angeles, will build 421 dwellings South St. and Lakewood Blvd. by his own forces. The estimated cost is $2,500,000.

Note—Additional bidding and contract news on many projects large and small, including the above items, appear in the Construction News section beginning on page 141.

OBITUARY

Harry Edgar Horrocks, Sr., 69, died Jan. 31 at Seattle, Wash. As a young man Mr. Horrocks worked in the engineering offices of the Northern Pacific Railroad in Tacoma, Wash., later serving as supply agent for the Western division of the Milwaukee Road. He was general manager of the West Coast Wood Preserving Co. from 1913 to 1944, when he retired.

Eugene L. McAllaster, 80, naval architect, died in Seattle, Wash., Jan. 30. As a consulting engineer, he had been on the Denny and Jackson streets regrade projects, and earlier had been with the Detroit Drydock and Shipbuilding Co. in Michigan. He was an 1889 graduate of the University of Michigan.

Burnett Hamilton, 58, city engineer of Alameda, Calif., for 12 years and engineer of Alameda County for 9 years, died Feb. 6. Before retiring in 1942, Mr. Hamilton supervised, among other projects, the construction of the High Street and Park Street bridges between Alameda and Oakland.

Charles Harvey, 71, civil engineer, for the last 15 years highway engineer, Department of Highways, Toronto, Ont., died Feb. 5. He was a graduate of the University of Manitoba.

Edward Frank White, 85, Southern Indiana's pioneer civil engineer, died at Quincy Feb. 5. He was the last remaining member of the last class of old Asbury College, predecessor of DePauw University. He planned and directed construction of many of the main highways in Owen and other Southern Indiana counties.

Halbert C. Fillinger, Vermillion County, Ill., surveyor and engineer, died Feb. 5 at Dana, Ind.

Leland E. Volk, 56, superintendent of public works at Rhinelander, Wis., for 20 years, died Jan. 22.

Samuel Chatwin, 73, retired Shreveport, La., contractor, and a resident there for 52 years, died recently. With a brother he formed the Chatwin Brothers Contracting Co. and the Red River Sand and Gravel Co.

Charles D. Hershberger, 64, for many years borough engineer of Mt. Pleasant, Pa., died there Feb. 6. He had served as right-of-way representative in Westmoreland County for the Pennsylvania Turnpike Commission.

John W. Heckart, 81, Columbus, Ohio, general contractor for more than 40 years, died Jan. 29.

John A. Stevenson, 53, superintending engineer, Canadian Vickers, Ltd., Montreal, for the last 21 years, died at his home in Montreal Feb. 5.

William W. Locke, 80, sanitary engineer for 38 years with the Metropolitan District Commission, Boston, Mass., died Feb. 5. He was graduated from Massachusetts Institute of Technology 1892 in sanitary engineering. After graduation, he was sanitary engineer for Brooklyn, N. Y., and later became assistant engineer in the New York State Board of Health.

Valentine Bernard Siems, 58, retired civil engineer, former president of the Water Board, Baltimore, Md., and former head of V. Bernard Siems & Co., consulting engineers, New York City, died Feb. 15.

Mr. Siems planned the water supply work at Camp Kilmer and other Army bases during the war. He started his career with J. G. White & Co., engineers and contractors. In 1908 he joined the Baltimore Water Department. During the first World War he was a construction engineer for the Army. In 1932 he formed his own firm, which did special engineering work for the U. S. government, for a number of states and municipalities, and for the National Defense Committee.

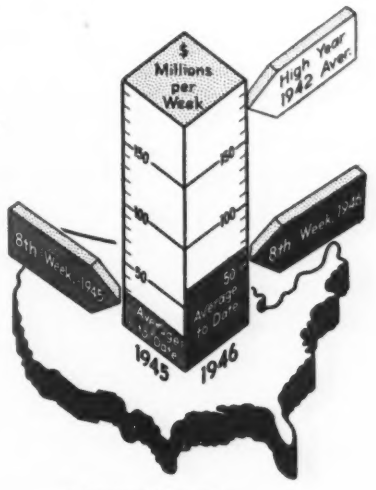
Glenn L. Parker dies, head hydraulic engineer

Glenn Lane Parker, 61, chief hydraulic engineer, U. S. Geological Survey of the Department of the Interior died in Washington, D. C., Feb. 12.

Graduated from the University of Kansas as a bachelor of science in civil engineering in 1906, Mr. Parker was deck officer in the U. S. Coast and Geodetic Survey in 1908, and since 1909 had served as an hydraulic engineer in the U. S. Geological Survey—district engineer at Tacoma, Wash., from 1913 to 1939, and chief hydraulic engineer in charge of nation-wide water investigation from 1939 until his death.

During the war, as head of this work, conducted through more than 100 field offices, Mr. Parker contributed largely to solving the water problems relating to many phases of war activities.

CONSTRUCTION ACTIVITY



As Reported this week to . . .
Engineering News-Record

CONTRACT VOLUME

Continental U. S. Only
(Thousands of Dollars)

	Week of Feb. 21 1946	Cumulative 1946 (8 wk.)	Cumulative 1945 (8 wk.)
Federal	$5,964	$55,196	$112,116
State & Mun.	10,702	108,106	24,657
Total Public	$16,666	$163,302	$136,773
Total Private	34,898	336,124	60,936
U. S. Total	**$51,564**	**$499,426**	**$197,709**

WHERE CONSTRUCTION ACTIVITY ORIGINATED THIS WEEK

Type of Work	Dollar Volume (Thousands) This Week	Cumulative 1946 (8 wk.)	Cumulative 1945 (8 wk.)
Waterworks	$1,285	$8,389	$6,189
Sewerage	496	4,540	6,273
Bridges	1,604	15,673	5,829
Highways	6,135	56,334	10,057
Earthwork, Waterways	2,709	31,312	3,691
Buildings, Public	4,141	36,755	77,337
Industrial	11,724	142,147	39,584
Commercial	20,416	174,250	13,630
Unclassified	3,054	30,026	35,119

NOTE: Minimum size projects included are: Waterworks and waterway projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1946 (8 wk.)	Cumulative 1945 (8 wk.)
NON-FEDERAL	$136,287	$119,335
Corporate Securities	62,704	9,595
State and Municipal	73,583	109,740
FEDERAL	158,320	77,137
Total Capital	$294,607	$196,472

ENR INDEX NUMBERS

Index Base = 100	1913	1926
Construction Cost	319.52	153.59
Building Cost	243.94	131.86
Volume	189	83

EDITORIALS

VOLUME 136 NUMBER 8

February 21, 1946

Unfair to Sanitary Engineers

SANITARY ENGINEERS need a defender. When the United Nations Organization site-seeking committee made an interim report recently, the chairman is reported to have stated that one of the areas under consideration "presented serious sewage problems". With the revelation that this area eventually was ruled out as a site of the UNO's home, there were whispered allegations that the sanitary engineering profession may have been unequal to the task of meeting a crucial obligation of international import. It is to be hoped that those who profess an interest in the good name of sanitary engineering, will act quickly to dispel such snide notions. No sanitary engineer has a "soul so dead" or ability so dull as not to be able to cope with any waste disposal problem posed by the UNO, nor to do so without a proper regard for international sensibilities. For example, the design of sewage treatment facilities might include an Imhoff tank, a Simplex activation unit from England, or a Kessner brush aerator from Holland, and, perhaps, chlorinators from the U.S.A. For garbage disposal, the Beccari process from Italy, or controlled tipping as practiced in Great Britain might receive consideration. All of which leads to the conclusion that the sanitary engineer should not be dealt with harshly by his professional brethren as a result of the UNO committee's decision. Factors other than those relating to sanitation must have weighed heavily in the committee's final judgment.

Open-Panel Convention Meetings

AN ALL-TIME HIGH in program participation was reached at the recent annual meeting of the American Association of State Highway officials in Oklahoma City, when the number of prepared papers was held to a minimum and two afternoon sessions were devoted entirely to open-panel discussions on current highway problems. Directed by a seven-man panel, each member of which came prepared to discuss his assigned subject, both sessions were so productive of informative comment as to argue strongly for continuation and enlargement of this means of handling convention meetings. The high degree of interest shown was manifested not only in lively and pertinent discussion, but also by a sustained full attendance. Such is not generally the case when the program consists of prepared papers presenting the views of only a few. Apparently, the average engineer attending a convention prefers to hear brief views on many topics rather than protracted discussions of a few selected subjects.

Cyclopean Quay Wall

CYCLOPEAN MASONRY, so widely favored at one time for dams of gravity section, was used again during the war emergency in a manner to indicate that such masonry still has superior advantages over mass concrete under some conditions. When ammunition loading facilities were needed in a hurry at Long Beach, Calif., the current scarcity of sheetpiling and lumber led the designers to consider building a concrete quay wall to serve as the pier; and the availability of quantities of large stone without long haul or delay in delivery suggested the use of cyclopean masonry for part of the wall. This plan was followed, using an ingenious combination of dumped and derrick-placed rock and bucket-placed concrete to form most of the underwater part of the wall, as described in this issue. Large savings in concrete and in forms resulted, and the wall, which will serve as a permanent part of the harbor works, promises to have a much longer life and lower maintenance than lighter, competitive types of construction.

South American Water Supplies

READERS OF THE ARTICLE on the Caracas Venezuela, $20,000,000 water supply project (page 85) should not assume that this work is typical of the sanitary engineering developments that will command attention in South America. Perhaps the only other waterworks project of comparable scope—and only half the size—is that contemplated for Guayaquil, Ecuador, where three North American contracting firms already have done preliminary work. Much water supply work is needed in South America, but

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the bulk of it is on a modest scale more nearly comparable to that for our smallest villages and towns. This fact should greatly limit the opportunities for participation that North American engineers may visualize. The Caracas project is an exceptionally large undertaking. To picture it as representative of post-war sanitary developments in South America would not be a realistic appraisal of the situation south of the border.

The Key to More Housing

THE new Housing Administrator, Wilson Wyatt, hardly took time to hang up his hat before he handed the country a building program that in both scope and definiteness is worthy of the emergency it seeks to solve.

That the program contains proposals that are unnecessary and, in our opinion, unsound, is not immediately important if it succeeds in smashing the complacency with which the grave question of new housing has been approached. By setting as goals the amount of housing that is needed, instead of that which it seems easily possible to provide, a challenge is laid down that should generate maximum effort. By listing definite recommendations of steps to be taken to implement the program, greater opportunity is offered for discussion on some other basis than that of the emotional generality that has surrounded the subject so far. Some of that discussion is appropriate before Congress acts on the proposals.

For example, it is evident that the real obstacle to housing progress is a lack of materials. The Wyatt program recognizes this fact by emphasizing the need for "greatly expanded production of conventional and new type materials", but it then goes on to recommend incentives such as premiums for increased output, guaranteed markets, special tax privileges and governmental absorption of risks, overlooking the fact that these are devices for a receding rather than an expanding economy. None of them is now necessary, and each would merely complicate a manufacturer's operations and frustrate his enthusiasm. All that American industry needs is a chance to make a profit—a gambling chance to make a substantial one and a fair chance to break even. That is free enterprise, and that is the process by which the maximum useful housing will be built.

To talk of guaranteeing markets at a time when the greatest market in history is free for the taking does not make sense; to suggest paying government premiums for increasing production is contrary to the principles of the free enterprise system.

Obviously, since price ceilings are to be maintained, the only way to provide the necessary chance to make a profit is to liberalize the ceilings. Whatever inflationary effects result will be minor compared to the fact that materials will begin to roll off the production lines; and increased production is the only protection against inflation.

Nor is there any reason why wages need be tied to increased ceilings. On the contrary, to increase wages until production is attained will merely hold industry on the present dead center of limping activity—and at a higher level of costs that would be a detriment to labor. A little statesmanship on the part of government could convince the workers of the soundness of such a program, and of the certainty of their benefitting from it as profits increase and costs go down.

The alternative to such a plan is a return to rigid federal wartime controls. If this were to be done and the resulting wasteful costs paid out of the federal treasury, a building program under such auspices could conceivably produce many thousands of housing units just as it produced thousands of military barracks during the war. But if three million housing units are built in the next two years under that system, they can be of little better quality than the barracks, which is not what the veterans want or deserve. Moreover, when we were through, the free enterprise system would still not be functioning, and more emergency measures would have to be taken. We would merely be prolonging war conditions instead of promoting the return to normalcy that is so much desired.

Mr. Wyatt showed courage and understanding, first in setting an objective of 2,700,000 houses by the end of 1947 and then in emphasizing the fundamental need of increased materials production and the recruitment of 1,500,000 new on-and-off-site workers to attain the objective. But either his courage or his understanding deserted him when he sought to implement his hopes by artificial incentives instead of by the simple device of providing materials manufacturers with the chance to gamble on a profit. Give them that, establish priorities and allocations to home builders until the materials start to flow, and American industry and labor will automatically do the rest.

Also, it would soon be evident that most other types of construction could soon go right along with house-building with only the most grandiose, long-time projects suffering any appreciable deferments. Sooner or later that must be the pattern if the veterans are to have jobs as well as just a place to live.

The Pan-American Highway

How Much of It Is Open to Travel?

Maurice E. Gilmore
Director of the Department of Transportation and Economic Development
Office of Inter-American Affairs,
Washington, D. C.

***Editor's Note**—The author for the past two years has been in charge of the program of the Office of Inter-American Affairs aimed, among other things, at bringing outstanding transportation engineers from Central and South America to this country for specialized training in American highway construction practices. The program also provides assistance to those countries in advancing their highway construction programs. This assignment has given the author an excellent opportunity to keep well informed of the rapidly changing status of the Pan-American Highway.*

ALTHOUGH A TRIP over the Pan-American Highway from the United States to Cape Horn is a most fascinating adventure to contemplate, it will be some time before the motorist can drive even as far as Panama. Now one can travel from Laredo, Texas, to Mexico City and onward about 50 miles south of Oaxaca, Mexico, a total of 1,156 miles. But, as far as the American motorist is concerned, the highway ends there, because there are gaps totaling some 400 miles between that point and the border of Guatemala.

The fact that the five Central American republics have, between them, some 1,000 miles of improved Pan-American Highway is of most interest to the local inhabitants of those countries only, as at present there is no way to get there by highway from the United States. However, it is believed that the missing sections in Mexico will be completed by 1947.

Between the Panama Canal and the border of Colombia there is another gap of nearly 200 miles through jungle country for the construction of which no provision has been made. This highway may not be built for many years.

Within the South American republics long stretches of the highway have been completed and are now being used extensively by the local citizens. But this mileage is closed to the North American motorist unless he takes his car to South America by steamer.

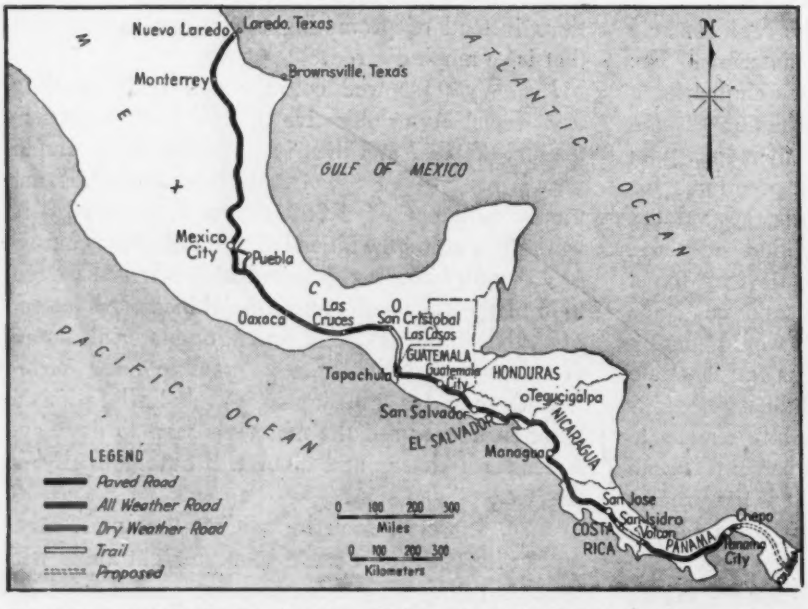


Fig. 1. To complete the Pan-American Highway from the U. S. to the Panama Canal, a 400-mile gap in southern Mexico remains to be completed, also between 200 and 300 miles in Costa Rica. Extensive work is now underway in both countries and by 1947 it may be possible to drive all the way to San Isidro, Costa Rica.

Good progress in Central America

To discuss the status of the highway in more detail let us return to Central America. The highway in those countries is now open at all seasons from the southern border of Mexico to the northern border of Costa Rica. One can drive the 553 miles from Guatemala City, the capital of Guatemala, to Managua, the Nicaraguan capital, in two days in dry weather and in three days during the rainy season. A passenger and express bus line now operates over the Pan-American Highway from Tapachula, Mexico, which is near the Guatemala border, to Managua, a distance of about 746 miles.

Up-to-date information shows the condition of the highway in Central America, country by country, to be as follows:

Guatemala—All-weather road from border to border.

El Salvador—Good paved highway for the length of this country, except for about 21 miles of rock-surfaced road in the southern part of El Salvador.

Honduras—All-weather road border to border, although a detour of about 19 miles is required in the rainy season.

Nicaragua—With the exception of two sections totaling 75 miles, which involve detours in the rainy season, an all-weather highway is provided across Nicaragua.

Costa Rica—In the north there are some 124 miles where cars can get through in dry weather with difficulty, and in southern Costa Rica there are 112 miles of trail where cars cannot get through at all. Between San Jose, the capital, and San Isidro the highway, in crossing the Talamanca range, climbs to 10,700 ft. above sea level and continues for 10 miles at an elevation of over 10,000 ft. This section is one of the most difficult portions of the entire highway to construct and promises to be difficult to maintain. But an American contractor is making good progress in building 71 miles of the most difficult portion.

Panama—Between the border of Costa Rica and the town of Volcan, 35 miles are poorly improved. However, from this point to the Panama Canal and 37 miles beyond to the town of Chepo—a total distance of 372 miles—a fairly good road, and for some sections an excellent paved highway, is available. In contrast, between Chepo and the border of Colombia there are about 200 miles of wild jungle country through which a route has never been surveyed. As there is no major economic reason why Panama should build this stretch, it is not likely to be constructed for a good many years.

Public Roads Administration Photos

Fig. 2. As part of the war effort the U. S. Army Engineers and the Public Roads Administration completed long sections of the road across Central America (ENR July 29, 1943, vol. p. 209). This work included many miles of rock-surfaced highway of excellent alignment in Honduras.

South America goes ahead

Good progress is being made in completing the Pan-American Highway network in South America. This network when completed, will provide a splendid route of communication uniting the ten republics and will play an important role in the economic development of that continent. It will prove extremely important for trade and pleasure travel.

The Pan-American Highway in South America is not a new road, contrary to the general impression. Instead it is a collection of old roads and trails, many of which were in existence before the white man came and are now being improved and connected to form a continuous modern highway network. Nor is the Pan-American Highway primarily a scenic tourist route—though many parts are of surpassing scenic beauty.

Throughout much of its length the highway is a highly important commercial route for both merchandise and passengers. The economic importance of the highway is increased because many of the South American republics are not connected by rail and because highways supplement railroads in those countries to a much

Fig. 3. In southern Mexico, where much construction work is underway, an old Spanish colonial bridge built centuries ago is utilized.

Fig. 4. Construction of the Pan-American Highway in South America is now well advanced, and when gaps in Ecuador are eliminated, it will be possible to start either at La Guaira, Venezuela, or Turbo, Colombia, both Caribbean ports, and drive all the way to Buenos Aires, Argentina, and then northeastward to Rio de Janeiro.

greater degree than in this country.

For example, there is no railroad connecting the capital of Colombia with either of its three neighbors, Venezuela, Brazil or Ecuador. Ecuador is also without rail connections with either of its three neighbors. Likewise, no railroad connects Peru with either Ecuador or Brazil, and, if one discounts the 40-mile Tacna-Arica line, it has no rail connection with Chile. Brazil, in turn, has no connection with Bolivia, Paraguay or Argentina, although it will have when construction work now underway is completed.

But those who would go touring to South America will be obliged to ship their cars to some South American port—La Guaira in Venezuela for example. Having reached La Guaira the motorist can easily drive through Venezuela to Colombia, through Colombia to Ecuador and through about half of Ecuador. Here he must make a detour by sea to get around two unfinished gaps in the road in Ecuador. In this case he would probably land at Tumbes in the north of Peru.

South of Peru his detour troubles are largely over for he can drive throughout the length of Peru—much of it over an asphaltic concrete highway—to Chile, through Chile to Argentina, and in Argentina over a fine, hard-surfaced highway to Buenos Aires. From Buenos Aires good roads lead to Bolivia, Paraguay and Brazil; or he can take the ferry across the estuary of the Rio de la Plate to Uruguay.

A more comprehensive report on the status of the highway in South America, country by country, follows.

Venezuela—The 731-mile section of the Pan-American Highway in Venezuela serves as the main east-west artery of that nation. Beginning at the port of La Guaira on the Caribbean the highway passes through Caracas, the capital, and then turns westward along the Andes to the border of Colombia. The entire route is used at all seasons and, although there are sections which are not hard-surfaced, trucks and buses operate between Bogota, Colombia, and Caracas, Venezuela. The distance from Caracas to the border of Colombia is 709 miles.

The road leading westward from Caracas passes through high mountainous country. At one point it climbs to 13,747 ft., which is the highest point on the Pan-American Highway, and at another point many miles away to 10,265 ft.

Colombia—In Colombia there are 2,293 miles of the Pan-American Highway. The three principal routes form a triangle in the center of the republic with the corners at Bogota, Murillo and Medellin. All of the 1,069-mile route across Colombia between Venezuela and Ecuador is designated all-weather construction.

On the 587-mile highway from Turbo on the Gulf of Uruba through Medellin to Bogota, about 50 miles between the first two cities remain to be constructed. This section is expected to be finished by the end of 1946. The Pan-Amercian Highway in Colombia does not touch Panama, as there is no highway in that part of Panama with which to connect.

To complete the 971-mile route from the Caribbean port of Cartagena to the border of Ecuador, passing through Murillo and Medellin, Colombia is now constructing a 435-mile section between Medellin and Cartagena. Some 125 miles of this route are now described as trails only, but when the work underway is completed it will be possible for the motorist from North America to use Cartagena as a starting

point for a South American tour.

Ecuador—Of the total of 739 miles of Pan American Highway in Ecuador 565 miles are improved and in service, 125 miles under construction and 49 miles remain to be started. The extremely mountainous terrain has made construction very difficult and expensive, but those sections which have been improved in recent time have had a marked effect on the economy of the country. Journeys which used to take seven days by mule-back are now accomplished in a few hours by bus.

The Ecuadorian Government recently awarded a $2,000,000 contract to the J. A. Jones Construction Company of Charlotte N. C., for the construction of the 125-mile section between Guamote and Tambo (*ENR* Oct. 25, 1945, vol. p. 547). This work is scheduled for completion by January 1947. When the project is completed only 49 miles of unfinished highway will remain between the border of Ecuador and Peru.

Peru—This republic has 2,128 miles of the Pan-American Highway within its borders and the entire mileage is passable at all seasons. As Peru has no longitudinal railroad, the highway provides the only land connection between the northern and southern states of the republic. Branching off from this highway are side roads penetrating the high valleys of the Andes.

From the border of Ecuador to the border of Chile the distance is 1,825 miles of which 877 miles are paved with bituminous material. The extension of the highway to Bolivia, which begins at Vitor, is 298 miles long. This section is passable at all seasons, although sand must be removed constantly from the road in the dune area.

Chile—Some 1,577 miles of the Pan American Highway network are located in Chile, of which more than 50 percent is good road and only 57 miles difficult to travel over. The driving time from the border of Peru to Santiago—a distance of 1,479 miles—is about 50 hours. As all northern Chile is a desert, the highway is passable throughout the year, although long stretches are not all hard surfaced.

The 95-mile road from Santiago upward in the Andes to Uspallata Pass, which forms the border between Chile and Argentina, is almost all paved. This route is used the year round, except when blocked with snow. When this condition prevails motor vehicles can use the 10,250-ft. Trans-Andean railroad tunnel, which is 10,500 ft. above sea level.

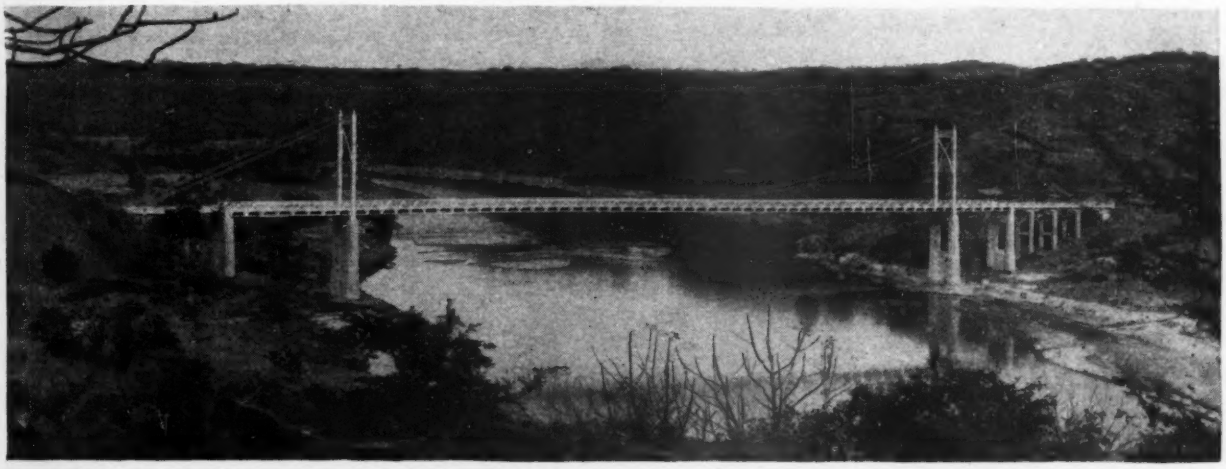


Fig. 5. Without outside financial help El Salvador in 1942 completed across the Lempa River, which is the largest stream in Central America, a 1,305-ft. suspension bridge with an 820-ft. central span (ENR July 16, 1942, vol. p. 74). An excellent road is provided the length of El Salvador, much of it being paved with bituminous macadam constructed by hand methods.

Fig. 6. Most recent international bridge completed in Central America is the 487-ft. 3-span continuous deck-truss structure spanning the Goascoran River and connecting El Salvador and Honduras. The structure was built in 1943 by the Frederick Snare Corp., New York, under PRA supervision.

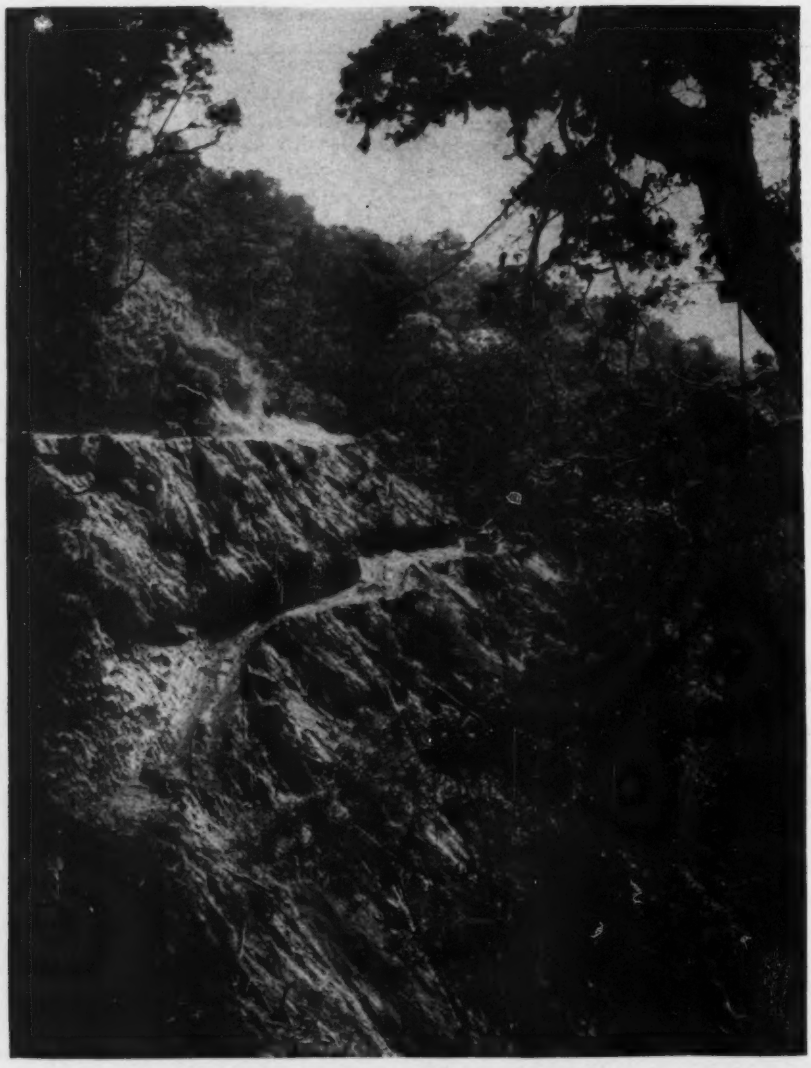


Fig. 7. In southern Costa Rica the Ralph E. Mills Co., Roanoke, Va., is at work under PRA supervision on a 71-mi. section where the highway climbs to an elevation of nearly 11,000 ft. This construction is considered one of the most difficult projects on the entire Pan-American Highway.

Uspallata Pass is 12,600 ft. high and much work remains in both countries to provide a paved highway over the pass. The distance between Santiago and the Argentine city of Mendoza is 220 miles.

As Chile has a longitudinal railroad between Santiago and Iquique, as well as excellent coastwise steamer service, the Pan-American Highway is not as important economically to that country as it is to some republics.

Chile's longitudinal highway continues southward from Santiago for 740 miles to Puerto Montt. It has been proposed that this road be included in the Pan-American Highway. Beautiful alpine lakes exist in southern Chile and southern Argentina and this area is a resort region with excellent hotels and highways. The climate is much like our own Pacific Northwest.

Bolivia—Of the 792 miles of the Pan-American Highway in Bolivia only 248 miles are passable at all seasons. The good part includes the 68-mile section between the border of Peru and the city of La Paz, and the 156-mile section between La Paz and Oruro. The remaining distance between Oruro and the border of Argentina is passable with difficulty in the dry season only.

Last summer the Compania-McGraw-Warren, which is made up of American contractors, received a $9,500,000 contract for constructing a 295-mile highway to connect the towns of Santa Cruz and Cochabomba to the southeast (*ENR* July 26, 1945, vol. p. 88). Although not a part of the Pan-American system, this road will be an important route and will permit much traffic to reach the Pan-American Highway.

Argentina—This country has within its borders more mileage of the Pan-American Highway than any other South American republic. The four routes connecting Buenos Aires with the neighboring republics of Chile, Bolivia, Paraguay and Brazil have a total unduplicated mileage of 3,252 miles and they are heavily traveled. Argentina has given the four routes preference in the appropriation of construction funds and is now devoting large sums to their improvement.

As construction continues and these roads are shortened by the elimination of detours the mileage will be somewhat less than:

Buenos Aires to Chile.....	809 miles
Buenos Aires to Bolivia	1,285 miles
Buenos Aires to Paraguay...	936 miles
Buenos Aires to Brazil.....	705 miles

Three of these routes duplicate the distance between Buenos Aires and Rosario and two of them that between Rosario and Santa Fe.

Traveling westward from Buenos Aires toward Chile, a paved road is available for 708 miles or to a point beyond Mendoza, and an all-weather road is available from that point for the remaining 100 miles to Uspallata Pass.

The 1,285-mile route from Buenos Aires to Bolivia is paved for most of the first 472 miles. But two sections of this highway in the north are recommended for dry season travel only, as the rains sometimes cause washouts and landslides.

The highway from Buenos Aires to Asuncion, the capital of Paraguay is 935 miles long and this route is paved for the first 398 miles. The remainder is designated dry-weather construction, but only one section of less than 62 miles gives trouble in the rainy season. Of the four international routes this one is least traveled because the river steamers on the Parana and Paraguay rivers, which the highway parallels, provide excellent passenger and freight service between Asuncion and Buenos Aires.

Travel from the Argentine capital to Brazil via the city of Parana, Argentina, or the northern route became much easier recently when the new in-

ternational bridge crossing the Uruguay River at the Argentine city of Paso de los Libres was completed (*ENR* Nov. 30, 1945, vol. p. 692). This route is paved for the first 311 miles from Buenos Aires, or as far as Santa Fe. In the remainder of the route there are sections which cannot be used in the rainy season.

Uruguay—In Uruguay there are 380 miles of the Pan-American Highway, most of this mileage being paved. The connection with Argentina is via ferry, a 31-mile trip between Buenos Aires and Colonia across the Rio de la Plata. An international bridge 4,526 ft. long spans the Jaguarao River at Rio Branco connecting with the town of Jaguarao on the Brazilian side.

While Punta Arenas, Chile, on the Straits of Magellan—the most southernly city in the world—is not included in the Pan American Highway system at present, it may be some day. It, therefore, may be of interest to note in passing that Buenos Aires is connected with Punta Arenas by an all-weather highway over which bus service is now available.

Brazil—When the construction now underway in Brazil is completed that country will have 1,705 miles of unduplicated Pan-American Highway. The route between Rio de Janeiro and Porto Alegra, 984 miles, will serve both the route leading to Argentina and the one to Uruguay.

Some 293 miles remain to be completed between Porto Alegre and the border of Uruguay, 355 miles between Porto Alegre and the border of Argentina, and 199 miles between Curitiba and Lagos, or a total of 847 miles to provide all-weather highways over these two routes. At present there are poor roads which can be negotiated in the dry season between the points listed, but they have a much greater mileage than the proposed new routes. It is reported that the new roads, now under construction, will be completed by the end of 1947.

While the Pan-American Highway through Mexico and the five Central American republics will always be one of the continent's great tourist attractions, its most important role in both Central and South America will always be that of binding together those countries, improving their economy and raising their living standards.

The road has already produced great improvement in the internal economies of the countries by making possible exchange of goods and rice, corn, and beans—the three universal basic foods in Latin America. There is seldom a year in which floods or drought do not ruin a large percentage of one of these crops in some part of Latin America, while a neighbor republic has an abundance of the same staple. However, before the advent of the highway, cost of production plus cost of coastwise transportation, even for so short a distance as 300 miles, boosted the price of the commodity far out of reach of the people who needed it most. Thus, incredible as it seems, when Costa Rica suffered a shortage of rice, she found it cheaper to import from Saigon, China, via Hamburg and the Panama Canal, than to get it from neighboring Nicaragua.

Many additional benefits will materialize when this link between North and South America is completed. Remember that until 1931, the only two Middle American countries connected by road were Mexico and Guatemala. The others have lived for centuries side by side in fear and mistrust of each other.

In contrast, when automobiles and trucks are once more obtainable a tremendous increase in both tourist and business travel by highway between the American republics will result. Our South American neighbors are keen to see the more distant parts of their own country and to visit their neighbors. Tourist travel has long been an important factor in the economy of Uruguay and Chile, both of which derive much revenue from summer visitors from populous and wealthy Argentina. Many republics have active automobile associations and state-supported tourist bureaus which foster tourist travel in every way. In view of these factors, highway travel, that great promoter of international goodwill and understanding, is destined to make our good neighbors even better neighbors in the years to come.

A USEFUL TABLE OF HIGHWAY DISTANCES

	Miles
Washington, D. C. to Mexico City	2,579
Mexico City to Guatemala City	1,182
Guatemala City to San Salvador	165
San Salvador to Managua	395
Managua to San Jose	291*
San Jose to Panama City	560*
Panama City to Bogota	788*
Caracas to Bogota	1,083
Bogota to Quito	859
Quito to Lima	1,753*
Lima to Santiago	2,458
Lima to La Paz	1,056
Buenos Aires to Santiago	906
Buenos Aires to La Paz	2,008
Buenos Aires to Asuncion	936
Buenos Aires to Montivedeo	141
Buenos Aires to Rio, via Montivedeo	1,687
Buenos Aires to Rio, via Paso los Rios	2,117
Montivedeo to Rio	1,546
Washington, D. C., to Buenos Aires	11,230*
San Francisco to Buenos Aires	11,226*
Ottawa, Canada, to Buenos Aires	11,974*
Fairbanks, Alaska, to Buenos Aires	14,479*

* Distances are approximate.

Imperial Oil Co. Photo

Fig. 8. In Peru, like many of the South American republics, the mountainous terrain traversed has made construction slow and costly. In traveling between Lima and Arequipa, sharp curves are encountered, but much of the road is paved.

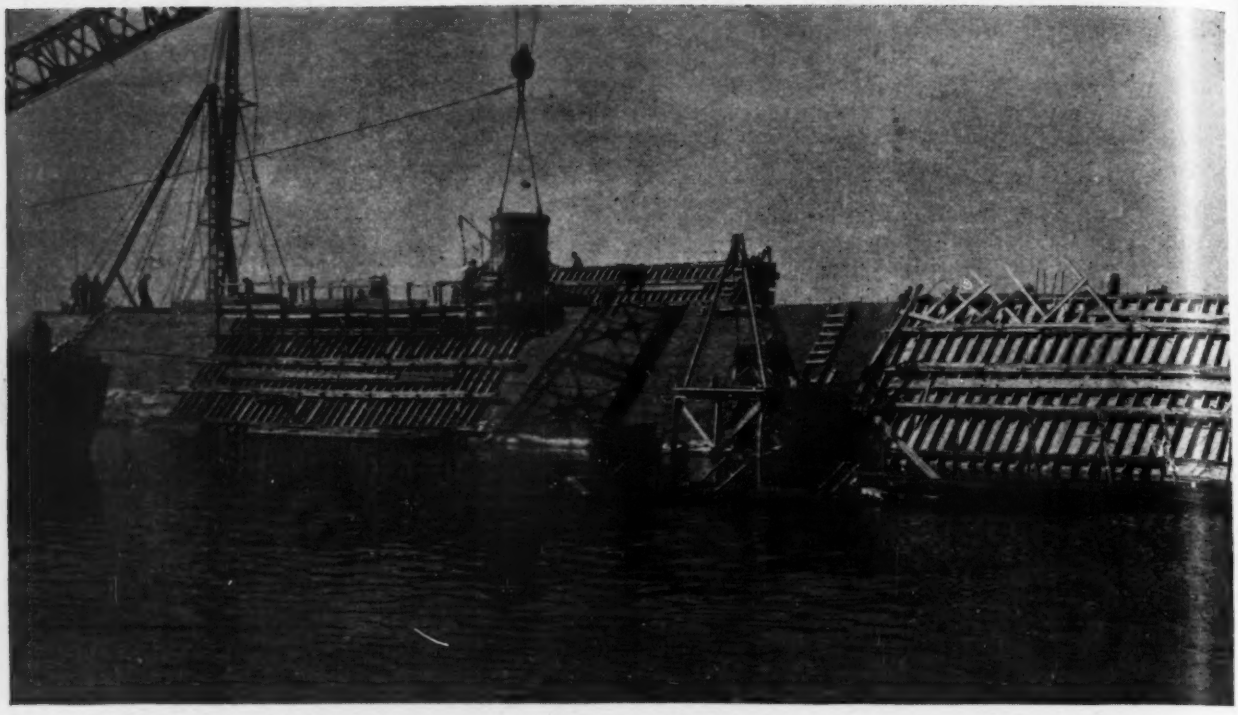


Fig. 1. Pouring an intermediate concrete monolith in the quay wall. This is the portion that extends from El. —2 to El. +16.

Cyclopean Pier Construction

Kenneth P. Peel
Senior Engineer and Assistant Chief,
U. S. Engineer Office, Los Angeles, Calif.

Contents in Brief *— An explosives-loading pier at Long Beach, Calif., in order to avoid critical materials in wartime and to get maximum strength and durability, was designed with a cyclopean concrete quay wall built in such a way that only one face had to be formed. Random stone shipped from the quarry in wire rope slings was placed from floating derricks, after which interstices were filled with tremie concrete.*

SPEED OF CONSTRUCTION with minimum use of manpower and critical materials during wartime were primary requirements and cost was a secondary consideration in designing and building the explosives loading pier at Long Beach, Calif. Because of the vulnerable nature of the freight handled, information about the structure was closely restricted and the following has only recently been released.

Safety requirements made it necessary that the wharf be in an isolated location but it had to be easily accessible to permit topping-off ship cargoes without undue time loss. As no available facilities were found in the area where the pier was needed, it was decided to build a new pier. The location selection was near the outer end of the breakwater that shelters Long Beach harbor. In this location the two required berths of 600-ft. length could be constructed where the minimum low tide depth would be 35 ft. Furthermore, there would be easy access from trunk line railroads and a relatively inexpensive fill would create the required storage area for 150 railroad cars.

TOTAL COST OF THE QUAY WALL

Exclusive of appurtenant works

122,617 tons stone at $4.00	$490,468
48,455 cu.yd. concrete at $12.00	581,460
8,836 cu.yd. concrete at $13.00	114,868
Cement furnished by United States	164,500
Engineering overhead, and surveys	84,204
TOTAL	$1,445,500

The directive concerning construction of this pier came with instructions that plans and specifications were to be completed and ready to forward to the Chief of Engineers for approval within eight days. This requirement was met.

The general construction plan included a pier about 1,400 ft. long, a riprapped fill along the inner side of the Long Beach breakwater to provide access and hydraulic fill totaling some 2,890,000 cu. yd.

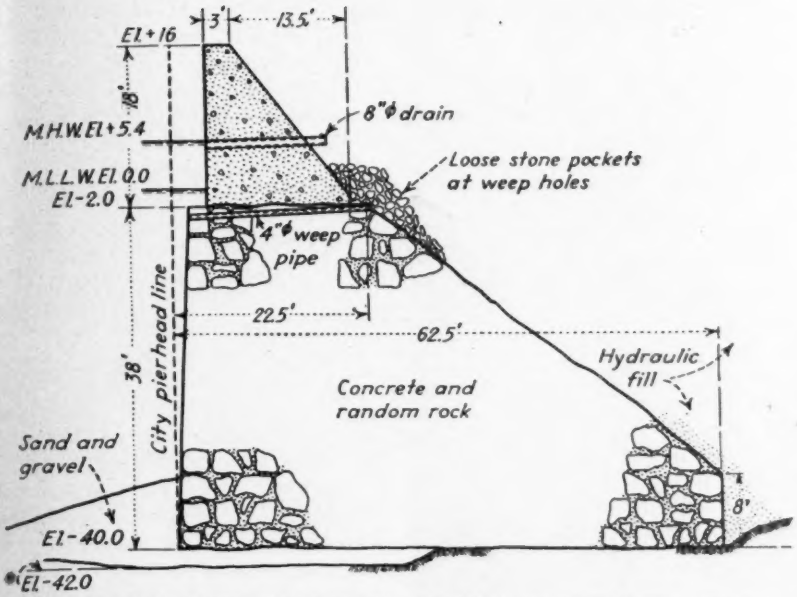


Fig. 2. Details of concrete quay wall designed to resist earthquake forces.

After studying various alternatives it was decided to build the two-vessel berthing space in the form of a quay wall consisting of cyclopean masonry. This was logical because cement, aggregate and quarried stone were not critical materials and could be had on immediate delivery in any required amount.

Forms on front face only

The quay wall would not only provide the berthing space needed but would serve as a retaining wall for the large fill. To save time and to reduce the number of marine divers needed to place subaqueous concrete forms for the quay wall, it was decided to use forms only for the front face which is practically vertical and to take care of back and end slopes by using care in placing the concrete. The concrete mix had seven sacks of cement per cubic yard (4-in. slump) and this was found to stand with a uniform slope of 1 on 2 when placed under water by tremies. However, these slopes were required to be restrained by stone dikes.

The wall was designed (Fig. 2) for construction in two sections: From El. —40 to El. —2 cyclopean, bucket concrete was used and from El. —2 to El. +16 ordinary mass concrete was placed in wood forms by tremie. The two parts of the wall were bonded by keying the upper portion into the base and by ¾-in. round bars on 3-ft. centers embedded in the lower portion and allowed to project into the top section to transmit tension if uplift should develop.

This bonding was part of the provision for stresses that might be caused by earthquakes. The allowance for earthquake forces was 0.1g, and this was used in all phases of the design.

The sequence of construction operations was: (1) hydraulic fill for access roadway along the bay side of the breakwater and for a construction area (Fig. 3) between the breakwater and the quay wall site; (2) construction of the quay wall, placing most of the material with floating derricks operating in the 170-ft. waterway between the construction area and the quay wall; and (3) completion of the hydraulic fill and revetment using the quay wall as a retaining wall.

Fill placed on flat slopes

Placement of the fill was not without its difficulties. Experience of local dredging contractors had been accepted as indicating that the fine sand of the harbor bottom when dredged and deposited under water without restraint, would stand on slopes of about 1:5. Experience in the first month of fill operations, however, during which time 309,000 cu.yd. of hydraulic fill was placed, showed that the slopes would be much flatter, ranging from 1:10 to 1:20.

Additional dredging equipment accordingly was provided and temporary wooden bulkheads from El. 0 to El. +12 were built around the edge of the construction area. In dredging the trench for the base of the quay wall, sloughing undermined these wooden bulkheads and harmful slides were prevented only by stabilizing the slopes with decomposed granite.

Similarly, in other parts of the fill area, completion of the work was expedited and quantities and costs were reduced by restraining the slopes. In some cases clay dikes were deposited to El. +2 and the space back of the dikes was hydraulically filled, after which bulkheads were constructed above this elevation to restrain higher fills.

Principal elements of the wood forms for the face of the lower portion of the quay wall were bents consisting of batterpiles cross-braced to vertical piles that served as supports to which the form panels could be

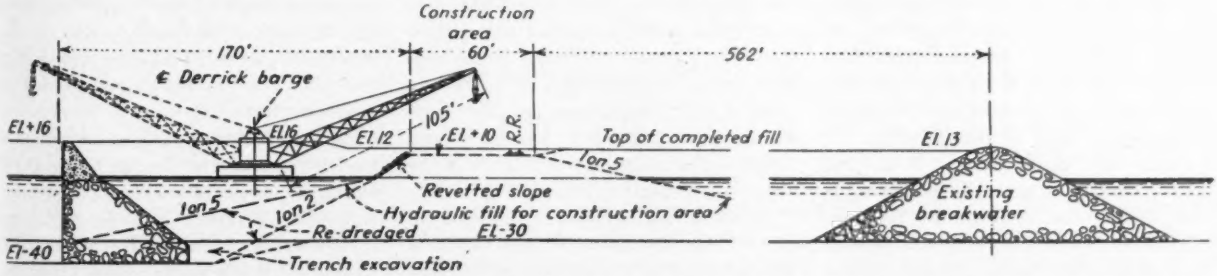


Fig. 3. Section through wall and the hydraulic fill behind the breakwater showing floating derrick and construction area.

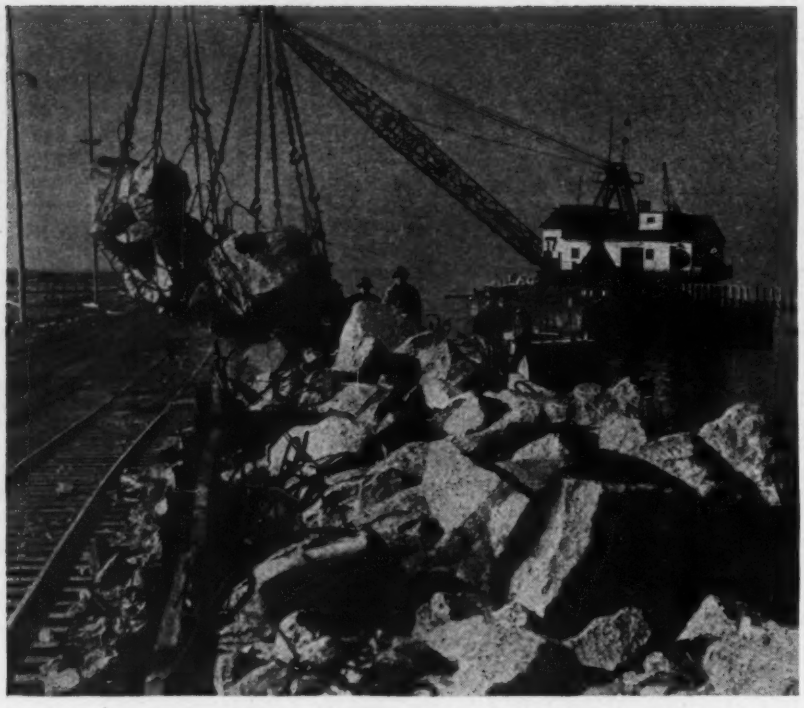


Fig. 4. Cargo nets of wire rope that speeded placement of rock were expensive in first cost and maintenance.

lashed. Structural stability of the forms was analyzed on the assumption that stone and concrete would be raised in 5-ft. lifts. All stresses were well within safe limits except the horizontal shear in the vertical piling, which was computed at 122 lb. per sq.in. This was considered rather high but as the forms were for temporary use it was approved, though the contractor was cautioned against overloading the forms.

Pile assemblies prefabricated

Pile assemblies were prefabricated, floated to the site and driven by a floating driver. Only the connections between the two driven elements, namely, the cross braces between vertical and batterpiles, were made under water. Form panels were prefabricated on the construction area fill and underwater connections were made by six marine divers. The contractor planned to strip and reuse the panels but this was found impracticable and the entire front face of the wall was paneled.

Stone was dumped in 5-ft. layers, taking care to keep all stone back at least 3 ft. from the form on the vertical face. Then concrete was placed by bucket until voids between stones were filled and a layer of concrete covered them. The lower part of the wall, 38 ft. high, was poured in six lifts. The portion above El. —2 was ordinary mass concrete.

Most of the stone and all concrete was moved into final position from the construction area by floating derricks operating 105-ft. booms with a 30-ton capacity at 50-ft. radius.

Stone-handling facilities

The stone came by barge from Catalina Island and by rail from a Riverside quarry. Most of the rail deliveries came in wire cargo nets. These were made of ⅝-in. wire rope with about a 12-in. mesh, were 14 ft. square and were loaded at the quarry, four to a flatcar. Both fabrication and repair costs for the nets were high but only a small percentage of small stones was lost through the meshes and the nets were convenient in making the desired accurate placement. Stone from hopper barges was dumped directly into place; rock that came on flat deck scows was unloaded by bulldozer. Results when placing rock from scows were surprisingly good.

Concrete was brought to the job in transit-mix trucks and also from a mixing plant set up on the construction area. Placement in the wall, ranging up to a maximum of about 1,500 cu.yd. per day, was made with 4-cu. yd., bottom-dump buckets protected for under-water delivery by weighted, heavy canvas covers.

In the lower part of the quay wall, which was completed three months after the first stone was placed in the bottom layer, 122,617 tons of stone (about 54,400 solid cu.yd.) and 48,455 cu.yd. of concrete was used. A slight overrun in the stone, as compared to estimated quantities, was caused by overdredging in the trench, penetration into the bottom, slight settlements and overbuilding of the side slopes. Concrete quantities were in substantial agreement with original estimates.

The upper part of the quay wall was divided into 27 sections or monoliths. Concrete was placed successively in alternate sections so that each alternate pour could be against concrete already in place. Forms were stripped after the second day and reassembled for the next unit. Total elapsed time in placing the 8,836 cu.yd. of concrete in the 27 monoliths was 36 days. Cost of the quay wall, exclusive of appurtenant work, is given in the accompanying tabulation. Analyses of actual cost gave $1,033 per lin.ft. for the 1,400-ft. length of quay wall. Over-all figures on the job as a whole ran very close to preliminary estimates and are believed to be much the same as would have been required for a sheet-pile bulkhead with a relieving platform. As built, the project as a whole cost about $2½ million and was completed, by dint of much three-shift work, in 8½ months.

Direction of work

The work was carried out under the direction of the Los Angeles District, U. S. Engineer Office. Col. Edwin C. Kelton, district engineer during design and start of construction, was succeeded by Col. Rufus W. Putnam, under whose direction the work was completed. G. B. Bebout was head engineer, chief of the Civil Engineering Division. The author was in immediate charge of planning and design and later coordinated engineering with construction.

H. W. McOuat was general superintendent of construction for the district engineer. Capt. Bruce W. Bennett was resident engineer. The general contract was held by the Macco-Case Construction Co., Verne Case, general superintendent.

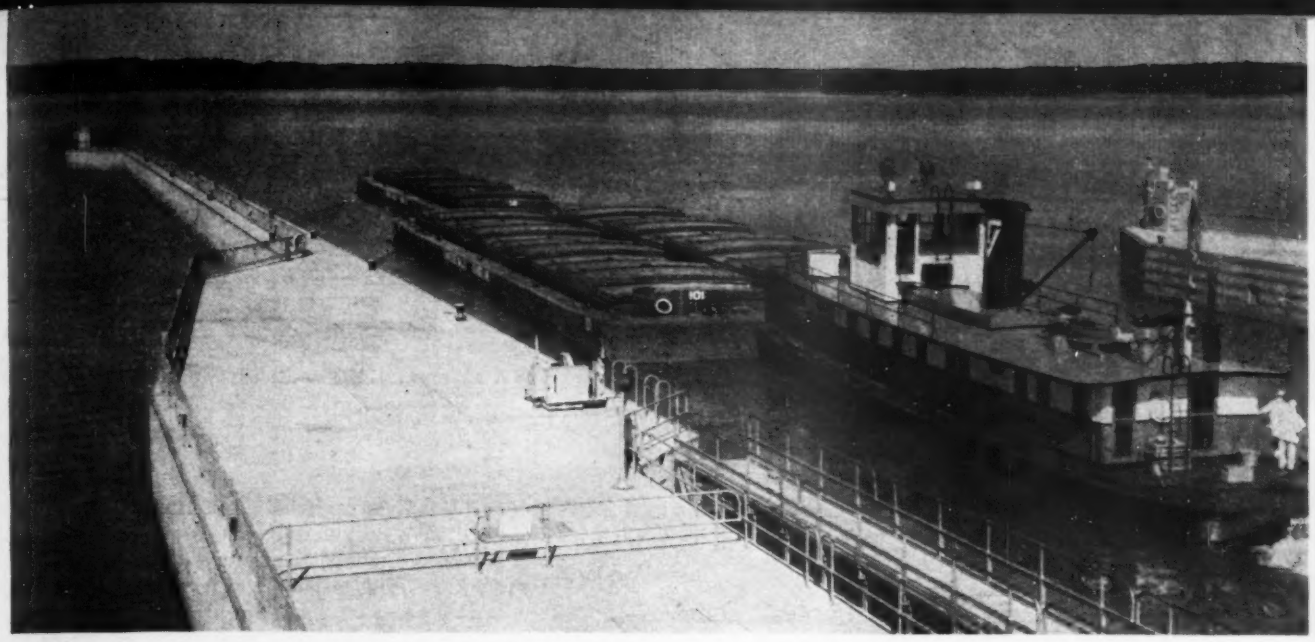


Fig. 1. Loaded grain barges move upstream on Tennessee River, making an estimated saving of about $3.00 per ton of grain.

Navigation on the Tennessee River

Part I—Current Trends In River Commerce

C. T. Barker

Chief, River Transportation Division, Commerce Department
Tennessee Valley Authority

***Contents in Brief**—Commercial tonnage on the Tennessee River, exclusive of locally hauled sand and gravel, has more than tripled in volume and the corresponding ton-mileage has grown five times since a commercially usable channel as far as Chattanooga became a reality in 1939. The 9-ft. channel from the Ohio to Knoxville is now virtually completed. It is estimated that by 1960 savings in transportation costs will amount to $2,000,000 per year more than depreciation of structures, cost of maintenance and the interest on the investment allocated to navigation facilities.*

A POPULAR QUESTION among engineers in regard to anything new is, "What good is it?" This is probably the first question that should be answered in connection with the nearly complete 9-ft. channel on the Tennessee River reaching from Paducah, Ky., to Knoxville, Tenn. Presumably the improvement is "no good" if the prospects for lower cost transportation are so poor that the facility is ignored by transportation interests. Conversely, there must be at least potentialities of substantial value if freight tonnages and ton-miles of transportation service are trending significantly upward. The record of traffic on the Tennessee River has a definite upward trend.

So much has been published as to the engineering features of the multi-purpose development of the Tennessee River that little such background need be given here. Suffice it to say that prior to 1933 nearly 100 years of desultory attempts at river improvement had resulted in dependable channel depths of 4 ft. from the Ohio River to Florence, Ala., 257 miles; 2 ft. to Chattanooga, Tenn., an additional 207 miles; and 1½ ft. to Knoxville, another 184 miles.

Improvements since 1933

Construction of a navigable channel having a dependable 9-ft. depth from the Ohio River to Knoxville was authorized by the TVA Act of 1933. Construction of a series of seven comparatively high locks and dams proceeded rapidly thereafter, which together with stream flow regulation by the new Norris Dam on the tributary Clinch River, provided 6 ft. of channel depth to Decatur, Ala., in 1938, 7 ft. to Chattanooga in 1939, and 6 ft., at minimum river flow, to Knoxville in 1943.

Filling of the Kentucky Reservoir in late 1944 and the completion of dredging at two of the locks above Chattanooga in 1945 has essentially completed the 9-ft. channel, Fig. 2. Only in the upper reaches of Hales Bar Reservoir, between Chattanooga and Chickamauga Dam, are lesser depths available part of the time. In this reach a minimum 8-ft. depth can be depended upon with 9 ft. available when water releases from Chickamauga are above average. The TVA expects to raise Hales Bar Dam, making available a minimum 9-ft. navigable channel from Paducah to Knoxville.

This channel joins the 9-ft. channel of the Ohio River at Paducah, Ky., and becomes a part of the inland waterway system of the United States, which provides about 5,700 miles of 9-ft. channel reaching Pittsburgh, Chicago, Minneapolis, St. Louis, New Orleans, Hous-

TABLE I—COMMERCE ON TENNESSEE RIVER

	Tons				
	1937	1939	1941	1943	1945*
Automotive Equipment	29	.....	6,160	39,329	7,500
Brick, Clay, Tile, and Cement	75,241	43,395	43,384	29,603	20,000
Coal and Coke	3,091	10,962	9,085	321,602	585,000
Construction Equipment	12,440	25,689	7,779	7,633	8,000
Forest Products	209,943	128,219	166,895	106,006	65,000
Grain	813	6,001	85,237	123,365	110,000
Limestone	.....	.....	.....	102,901	140,000
Petroleum Products	694	103,346	115,353	146,795	177,000
Pig Iron	.....	2,262	16,758	137,801	.....
Steel Products	26,062	26,094	9,499	40,270	38,000
Miscellaneous	6,987	26,790	5,200	43,169	6,000
Subtotal (exclusive of sand, gravel, and stone)	335,300	372,758	465,350	1,098,474	1,156,500
Sand, Gravel, and Stone	1,041,807	742,455	2,628,316	1,770,744	1,430,000
Total	1,377,107	1,115,213	3,093,666	2,869,218	2,586,500

Cross-river freight-car ferry at Guntersville and highway ferries excluded.
*Estimated.

ton, and Mobile, Fig. 4. It connects also, by way of the Ohio and Mississippi rivers, with the 6-ft. channel of the Missouri River leading to Kansas City, Mo., and Sioux City, Iowa.

The significant change in commercial usefulness of the channel came with inauguration of 7-ft. navigation as far upstream as Chattanooga in 1939. By that time it was possible to reach all of the larger ports (with the exception of Knoxville) with at least a "pay load" although barges still did not have the advantages of full 9-ft. draft. The record in Fig. 3 shows the effect that the improved channel has had on river commerce in terms of increased tonnages, improved traffic composition and added ton-miles of transportation service. The traffic data in Fig. 3 and elsewhere in this article, except as otherwise noted, were furnished by the U. S. Army Engineers.

Long-haul, high-value freight

Two interesting trends are revealed by Fig. 3. The tonnage graph at the bottom shows a progressive shrinkage in the relative importance of sand and gravel and substantial increases in higher valued freight, such as petroleum products, coal and coke, iron and steel, and grain. Especially significant are the data on ton-miles since they show the actual amount of transportation service rendered. Beginning with 1938 the ton-mileage increased in every year except 1944, and in 1945 estimated ton-mileage is over five times as great as that of 1937.

The fact that the upward trend in ton-miles is much sharper than that in tons shows that the proportion of long-haul traffic has grown progressively larger while short-haul traffic, such as sand and gravel, has become progressively a less important part of the total. Thus, the river has become more and more an arterial waterway. Calculations made on the basis of excluding government construction materials indicate that this trend is independent of the movement of materials to TVA structures.

Petroleum, grain, and coal important

Further particulars for the period 1937 through 1945 are shown in Table I. Petroleum products began to move in volume in 1938, and present movements total about 177,000 tons annually to points all along the river. Volume grain traffic began in 1939, with present movements totalling about 110,000 tons per year being transported upstream to elevators or mills at Decatur, Guntersville, Chattanooga, and Knoxville.

Large-scale coal shipments from South Pittsburg, Tenn., to lower river steam and munitions plants began in 1942. In 1944 coal began moving from the Ohio River, to the Watts Bar Steam Plant, 530 miles up the Tennessee and later to Muscle Shoals. Total coal shipments on the river now aggregate over 500,000 tons annually. Limestone shipments from Guntersville reservoir to Wilson Dam now amount to 140,000 tons per year. Limestone is used in making calcium carbide, necessary in the manufacture of synthetic rubber.

Another important movement is motor vehicles. The first shipment of passenger automobiles, from Ohio River points, arrived at Guntersville, Ala., in Dec., 1940 and by March 1942 about 5,000 units had been shipped. During the war over 20,000 army vehicles were moved from upper Mississippi and Ohio river points via the Tennessee River to southeastern camps.

The commodities above and many others have been carried in bargeloads as well as pig iron, acid wood, lumber, logs, poles and piling, clay, brick, fertilizer, machinery, crushed stone, cement, mussel shells, and sand and gravel. Reduced traffic in sand and gravel has resulted from the diminished requirements of TVA dam construction on the main river. A total of 125 new tugs, cargo vessels, derricks, and barges, many of these for ocean service were built at Decatur, Ala., and moved down the Tennessee River.

Until the war intervened with the resulting barge shortage, there was a promising development of less-than-bargeload freight, including cotton

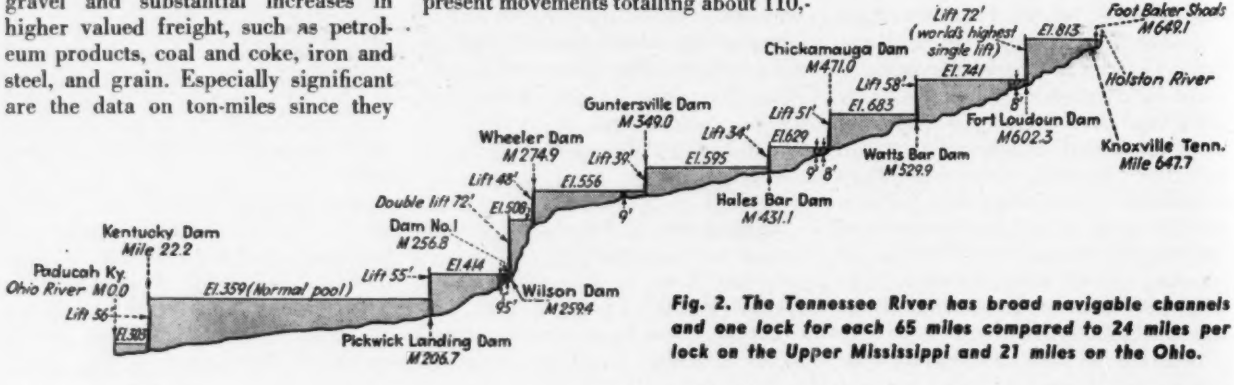


Fig. 2. The Tennessee River has broad navigable channels and one lock for each 65 miles compared to 24 miles per lock on the Upper Mississippi and 21 miles on the Ohio.

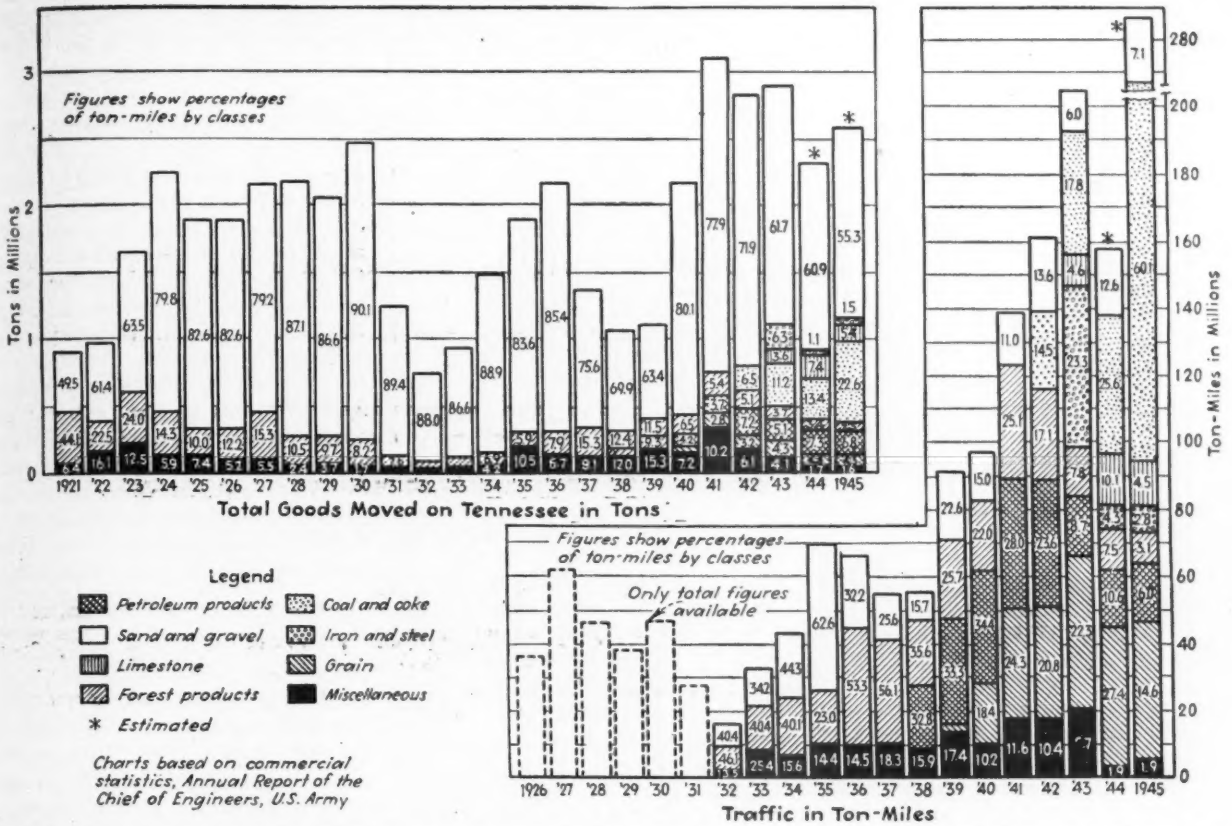


Fig. 3. Traffic on the Tennessee River, based on commercial statistics from the annual reports of the Chief of Engineers U. S. Army. Figures for 1944 and 1945 are estimated by TVA.

goods, soap, peanuts, stoves, canned goods, beverages, baking powder, paint, and glassware.

Most significant in the appraisal of long-term commercial prospects of the waterway are the data on commercial tonnage, exclusive of short-haul sand, gravel, and stone traffic. Such tonnage amounted to 465,000 in 1941; increased to 717,000 in 1942, or 54 percent above 1941; and increased to 1,113,000 in 1943, or 55 percent above 1942. In 1944 it declined to 919,000 tons (estimated) largely due to closure of Kentucky Lock from July to September for construction of the upper miter sill and to the cessation of some wartime traffic movements. However, estimated 1945 traffic, exclusive of short-haul sand, gravel, and stone totals 1,157,000 tons, 44,000 tons greater than the previous high reached in 1943.

So much for experience to date with the partially completed channel. What does the future hold after 9-ft. navigation and adequate barge-line services, terminal services, and joint barge-rail and barge-truck rates become realities?

The most recent study regarding the traffic that may be anticipated on the Tennessee River after completion of the 9-ft. waterway is contained in a report published by TVA in 1941 titled

Fig. 4. The inland waterway system now provides 5,700 miles of 9-ft. channel.

"Prospective Commerce on the Tennessee River." The data on which this report was based were obtained from some 3,700 shippers in 191 cities and towns located in the tributary area directly affected by the Tennessee River. Nearly 50 percent of the total tonnage reported on the questionnaires by prospective shippers was eliminated for one or more of the following reasons:

No saving could be effected by water, water-rail, or water-truck transportation.
Saving or barge-line revenue was too low.
Commodities were not adaptable for water transportation.
Circuity by water route proved too great to conform to joint barge-rail rate formulas prescribed by the Interstate Commerce Commission on similar existing waterways.

Tonnage that remained represented the amount that met requirements of adaptability, directness of movement, savings to shippers, and returns to barge lines. It was recognized, however, that the amounts of each commodity that actually move on the rivers are less than the total available, and a further correction was made by

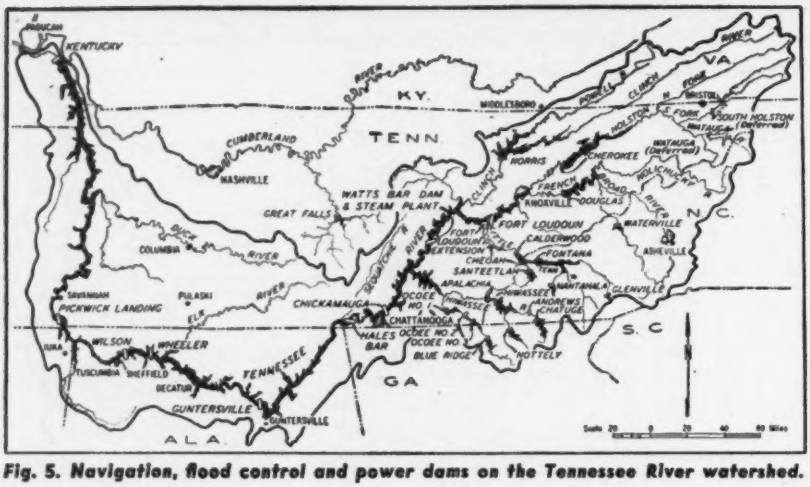


Fig. 5. Navigation, flood control and power dams on the Tennessee River watershed.

applying a factor which reflected the adaptability of each commodity to river transportation, its accessibility, the indicated amount of saving per ton, and the time factor. This analysis resulted in the further reduction of about 13 percent of the total tonnage originally reported. To allow for the probability, however, that all potential shippers were not reached during the survey, an arbitrary 10 percent of the reduced tonnage was added.

At the time this survey report was under preparation (1940), it was impossible to take into account the changes in business activities, construction schedules, and other factors brought about by the war. The estimate was based on the assumptions that the 9-ft. channel would be completed in 1945, that river terminals would be available at important shipping and interchange ports, that joint rail-water and truckwater rates would be available at the usual differentials under all-rail rates, and that adequate common-carrier barge service would be established on the Tennessee River and inter-connecting waterways. All of these potential developments have been delayed to some extent by the war. If the country returns to substantially a peace time economy in 1946, it is believed that the estimates made in this report will still be valid and the results, therefore, are of value.

Substantial returns expected

It is now anticipated that in 1946 about 2,650,000 tons of freight will move on the Tennessee River, requiring about 1,425,200,000 ton-miles of transportation service on the Tennessee and inter-connecting inland waterways. In addition to the estimate for 1946, a 15-year projection of the traffic trend to 1960 has been developed on the basis of the growth of traffic on other comparable inland rivers. The results, adjusted in the light of more complete knowledge now available, indicates that the total freight on the river would amount to about 7,000,000 tons in 1960 with savings in transportation charges of about $9,100,000 per annum. Table II gives a commodity breakdown of this estimate.

It is notable in these analyses of future trends that the relative importance of low-valued commodities continues to shrink and the higher valued, long-haul freight continues to increase. For example, while the totals for actual freight in 1942 and anticipated freight in 1946 are about the same, sand and gravel falls from about 2,000,000 tons in the earlier year to 1,000,000 tons in 1946. This commodity increases in absolute volume to 2,600,000 tons in the estimate for 1960, but the savings constitute less than 3 percent of the total, whereas over 75 percent of the total savings are realized on higher valued commodities, such as grain, coal, petroleum products, iron and steel, and merchandise.

TABLE II—ANTICIPATED COMMERCE ON THE TENNESSEE RIVER IN 1960

	Estimated Matured Tonnages	Estimated Savings		Avg. Haul on the Tennessee	Ton-Miles on the Tennessee
		Per Ton	Total		
Grains	600,000	$3.47	$2,082,000	445 mi.	267,000,000
Forest products	340,000	.42	142,800	207 "	70,380,000
Brick, tile, clay and cement	60,000	.24	14,400	36 "	2,160,000
Coal—ex river	600,000	1.08	648,000	528 "	316,800,000
—local	450,000	.20	90,000	207 "	93,150,000
Petroleum products	600,000	5.50	3,300,000	455 "	273,000,000
Sand and gravel	2,600,000	.10	260,000	11 "	28,600,000
Other non-metallic minerals	550,000	.20	110,000	90 "	49,500,000
Iron and steel	250,000	2.70	675,000	557 "	139,250,000
Chemicals	100,000	3.69	369,000	178 "	17,800,000
Other traffic (Private Terminals)	400,000	1.30	520,000	216 "	86,400,000
Merchandise freight (Public Terminals)	450,000	1.95	877,500	380 "	171,000,000
Total	7,000,000	$1.30	$9,088,700	216 "	1,515,040,000

Navigation expenditures justified

Now as to the relation of benefits to costs. From the total investment in the multiple-purpose projects of TVA, the allocation of cost to navigation will be about $155,000,000. This represents the direct investment in locks and channels and a part of the investment in jointly-used structures. (For method of apportioning cost of jointly-used structures see "Allocation of the Tennessee Valley Projects," T. B. Parker, *Proceedings*, ASCE, December 1941).

Depreciation on the structures chargeable to navigation plus interest would amount to about 4 percent per annum on the capital investment, or $6,200,000. Operation and maintenance of locks and channels is estimated at about $750,000 per annum. Thus, the total annual charge against the waterway project would be about $7,000,000. As discussed above, the annual saving in transportation charges by use of the waterway would be about $9,100,000, or $2,100,000 more than the annual charges. It would appear then that, on the basis of the best estimates that can be made at this time, the long-range benefits will exceed the costs and that the undertaking to provide for river transportation in the multipurpose scheme is justified.

Channel improvements and shipping facilities on the Tennessee River will be covered in Part II of this article, by Mr. Barker, to appear in a subsequent issue.—EDITOR.

Some Further Thoughts on . . . .

Lessons From a Sludge Tank Explosion

A. M. Buswell; Richard Hazen; S. P. Leclercq; William J. Wenzel and Henry W. Taylor

IN THE ISSUE of Dec. 27, 1945, vol. p. 887, Henry W. Taylor, consulting engineer, described a sludeg tank explosion at Herkimer, N. Y., that had its origin in the formation of a heavy blanket of scum. On the basis of this experience he made a number of recommendations relating to the design and operation of digester tanks in order to minimize explosion hazards.

Mr. Taylor's expressed hope that his views might inspire discussion by others has resulted in the statements that follow. These contributions to better design and operating practice are made by A. M. Buswell, chief, Illinois State Water Survey Division; Richard Hazen of the firm of Malcolm Pirnie, New York, consulting engineer; E. P. Leclerq, sanitary engineer, Gibbs and Hill, Inc., New York; and William J. Wenzel, assistant chief engineer, Corwin & Co., Inc., consulting engineers, Great Falls, Mont.

Not the least interesting observation is made by Mr. Wenzel, who raises the question of applying radiant heating principles to digester tanks.

Says Mr. Wenzel: "Exposed heating pipes in sludge tanks apparently are a universal source of trouble. Why not bury these coils in the concrete floor and walls in the manner that has been adopted for radiant heating of buildings? Theoretically this should have many advantages; practically I don't know that it has ever been used. If it has, I would be interested to hear how it works."

This novel suggestion, when brought to the attention of an organization prominently identified with the promotion of radiant heating installations, elicited this reply in part: "It never occurred to us that perhaps the principles of radiant heating could be applied as suggested. Certainly the matter deserves some study and field research. Until this has been done, however, it would be best to forego a statement that would represent nothing more than an expression of opinion."

Comments and suggestions from the other contributors to this symposium follow, along with a final statement by Mr. Taylor.

Circulation Disperses Stiff Scum

A. M. Buswell
Chief, Illinois State Water Survey Division
Urbana, Ill.

Mr. Taylor's description of The Herkimer, N. Y. sludge tank explosion gives a very clear picture of the causes leading up to the unfortunate circumstance. His article recalls that about twenty years ago the Illinois State Water Survey laboratory engaged in rather extensive experiments in sludge digestion in the course of which we purposely contrived to duplicate various conditions resulting from improper operation. Our experiments with scum formation and control were described in an article (*Industrial and Engineering Chemistry, 21* 322. April, 1929) from which we quote briefly:

"Such a condition (heavy scum) arose in an experimental installation built for the study of the chemistry of sludge digestion. The tank had a capacity of 1,900 gallons and received about 30 gallons per day of fresh sludge of 97 percent moisture content from a sedimentation tank. The scum reached a thickness of 26 in. in about a month. It had a moisture content of 80 percent and was so stiff that a shovel was forced into it with difficulty. The liquor expressed from the scum had a pH of 5."

"Since the scum is practically a gel, it seemed likely that the liquor from which it had separated might serve to dilute and soften it. A pump and pipe connections were installed so that liquor from beneath the scum could be pumped up and allowed to flow onto the scum in a gentle stream. One-inch pipe was used, the rate of pumping was 10 gpm., and the discharge pipe was placed 2 to 3 in. above the scum. The operation was carried out so as to avoid all violent jet or spray action, since experience had shown that such action resulted in extensive foam formation."

"Ten days' circulation under these conditions completely disintegrated a 26-in. layer of stiff scum, and the gases evolved during digestion were allowed to escape smoothly into the gas collector. After the scum had once been softened and disintegrated, it was found that circulation for from 5 to 10 minutes a day prevented any further scum formation."

It is very gratifying to find that the method of scum control suggested many years ago was found successful in the first eight years of the operation of the Herkimer plant. We believe, as Mr. Taylor indicated, the continued satisfactory operation would have resulted had it not been for the mechanical failure of the jet nozzle.

Improving tank design

We agree most heartily with the first two suggestions for improving tank design given by Mr. Taylor. (These are: (1) Provide facilities for the prevention of floating sludge, these facilities to be removable through the cover for inspection and repair; and (2) eliminate all equipment from a sludge tank that cannot be removed for inspection and repair without dewatering the tank.—Editor)

However, from the operation of many tanks during the past years we are inclined to think that his third suggestion, namely, that some means for removing floating sludge should be pro-

vided, is unnecessary. From our own experiments as well as those performed at certain full-scale plants we are of the opinion that persistent application of liquid on top of the scum will result eventually in the complete dissipation of this nuisance. In our experiments the 10 days' circulation was sufficient to completely disintegrate a 26-in. layer of stiff scum.

Circulation disperses scum

We believe that if circulation of liquid to the top of the gas dome of the Herkimer plant had been applied continuously for a few weeks the scum would have dissipated without the very disagreeable procedure of trying to remove the scum from the surface. Furthermore, since scum is often very thick and compact it is doubtful if it can be removed by any sort of pumping procedure similar to that suggested by Mr. Taylor. The use of tank liquor instead of fresh water for softening the scum is usually cheaper and avoids dilution, especially when prolonged treatment is necessary.

Scum when it forms in sludge digestion tanks is composed of the more concentrated organic material usually in its most foul state of decomposition. Any attempt to remove this heavy, sticky (this adjective should perhaps be spelled with an "n" instead of with a "c") material results in a situation best described by the four letter word "m-e-s-s". Therefore, when the condition can be remedied without removing the material from the tank it is obviously more desirable to do so.

Before closing this discussion the writer cannot refrain from remarking that floating covers on both tanks would have made possible an operating routine that would have made it possible to remedy the situation without explosion hazard.

Careful Operation Controls Scum

Richard Hazen
Associated with Malcolm Pirnie
New York

Mr. Taylor reports serious consequences of a condition frequently encountered in sewage treatment plants. Where grease is disposed of by digestion or where heating facilities are absent or inadequate, the development of a thick layer of scum or sludge on the top of the digester is sometimes unavoidable.

In extreme cases this top sludge layer may become several feet thick and result in what is commonly known as an "upside down tank." At several of the naval installations in the southeastern states where very low temperatures do not occur often, heating facilities were not provided and conditions similar to those reported by Mr. Taylor were fairly common.

Submergence is helpful

If allowed to accumulate in the digester, the hard top layer becomes too dense to remove hydraulically and it is necessary to open a manhole and actually dig out the sludge. The need for frequent inspection is obvious. At one plant where digestion tanks had been maintained at insufficient temperature, the difficulty was corrected by drawing off the bottom of the digester contents and superimposing upon the top of the hard layer about one foot of fresh sludge and then three or four feet of well digested sludge. The weight of the fresh and digested sludge was sufficient to submerge the hard layer and digestion proceeded quite normally.

It has been found generally that if temperatures of from 95 to 100 deg. F. are maintained in the digester from the start, very little difficulty from scum deformation results. In the event that scum formation does start, it is very desirable to discontinue at least temporarily the disposal of grease in the digester.

Mr. Taylor has suggested that digestion tank accessories be made removable. Undoubtedly this is desirable but there is some question as to whether or not the recent more elaborate plans for heating sludge actually show an overall saving over the well-established installation of heating coils around the periphery of the tank. Water temperature, of course, must be carefully controlled. Difficulty with this arrangement usually results from insufficient heating coil area or the installation of lightweight pipe, inadequate supports, or poor joints. To "cut corners" in the design of digester accessories is poor economy. Ordinarily, the cost of dewatering and cleaning out a tank only once will cost more than savings realized in construction.

The explosion at Herkimer occurred in a fixed cover digester. However, the problem of removing scum and hard sludge layers from the top of digesters is common to both fixed cover and floating cover digesters. When it is necessary to actually dig out sludge from a floating cover tank, the cover is dropped down to the brackets and the possibility of an air-gas mixture results. While the writer believes that the floating cover in general gives the safer all-around installation, the particular difficulty at Herkimer might have occurred with either type.

Mixing and Dewatering Facilities

E. P. Leclercq
Sanitary Engineer, Gibbs & Hill, Inc.
New York

The Herkimer sludge tank explosion has emphasized again several salient features in design and operation that are worthy of note. In the writer's opinion, direct responsibility for, and the contributing cause of the digester failure was the presence of a sludge blanket, which when formed, became an unmanageable factor in digester operation.

Following a review of the facts, the following recommendations are offered to improve the design, namely: (1) variation in method of mixing; and (2) better facilities for dewatering.

Positive displacement of the sludge can be accomplished only by mechanical mixing using a gear motor-driven impeller and propeller. This method will provide a horizontal and vertical motion to the sludge and will tend to equalize the temperature throughout the tank. The number of mixers should vary in proportion to the size and capacity of the tank, so that movement takes place throughout the entire mass.

Design of the mixer should be such as to provide inspection of the component parts. For this, it is suggested that a suitable seal be provided to allow removal for inspection while the tank is in service. A coupling should be provided immediately below the

gear-motor stub shaft so that the propeller shaft may be raised. Incidental to the method of mixing, numerous sampling pipes should be provided in the tank cover to readily permit surface inspection of the sludge, taking of samples at various depths and determination of temperatures.

For dewatering facilities, the sludge control piping should be designed to allow operation of either the primary or secondary tank to function independently, and make provision for sludge to be withdrawn by gravity directly to the drying beds. The portion of the sludge that could not be withdrawn by gravity could be pumped preferably by a conventional sludge pump forming part of the permanent control installation. The use of a movable pump for sludge removal should not be necessary nor permitted, particularly one operating from the top of the tank.

Operating suggestions

Recommendations as to operating procedure are: (1) prevention of the formation of sludge blanket; and (2) positive purging of the tank prior to dewatering.

Creation of a sludge blanket becomes a hazard because it tends to prevent the escape of gas from the top surface of the sludge directly to the point of collection. As the mat increases in thickness, passage of the gas becomes retarded to a point where the only escape is at the periphery of the tank. Supernatant lines tend to clog, the efficiency of the mixer decreases and proper operating levels cannot be maintained. Serious damage has been done in the past when a sludge blanket was raised by the gas to exert an upward pressure on the top of the digester, and in one case, the top of the digester was lifted from the side walls.

When a tank is to be dewatered, elimination of all gases and gaseous mixtures is necessary. Moreover, adequate ventilation, both natural and artificial, should be provided while dewatering is taking place. All openings, such as manholes, sampling pipes, overflow chambers, gas domes, etc., should be open. Thus the existence of gaseous mixtures is entirely minimized. For a further precaution, an area completely encircling the tank should be roped off, posted with suitable warning signs particularly as regards open fires and smoking.

In conclusion, it might be stated that the obvious lesson derived from digester accidents emphasizes again the importance of careful analysis and study of design and operating factors when planning a treatment plant, and integrating a sound design with careful operation. Of secondary importance is the design and operation of heating coils. Past practices in design and construction have not produced the optimum results for which the coils are used. Perhaps a different method of heat transfer may eventually be found.

Top Jetting Is Effective

Henry W. Taylor
Consulting Engineer, New York

A review of the previous discussions suggests these comments:

The Herkimer tank operated successfully for eight years with top jetting by secondary sludge liquor and it is known that the top sludge formed only after the jetter nozzle fell off and nullified its efficiency. The continued efficient operation of other installations equipped with top jetters further proves the adequacy of this device.

However, the writer does not feel that mechanical mixing is the only method for agitation, mixing and temperature-moisture control, nor would he claim that the hydraulic method is the only recourse.

In the writer's experience, there is no alchemy about a floating cover in itself or its operational routine to guarantee the absence of top sludge or its removal without hazard. Most of the serious cases of heavy top sludge, with which the writer is personally acquainted, developed under fixed covers.

The suggestion to provide for the withdrawal of top sludge from the top apparently needs brief elaboration. The writer still doubts if this removal is, in the general case, theoretically necessary. A parallelism may be cited in incinerator design. Theoretically, municipal refuse requires no auxiliary heat. There are brief periods, however, when an auxiliary heat, which is quickly available, is worth its weight in gold. When you need it, you seriously need it.

Similarly, facilities for withdrawing top sludge from the top are potential facilities that may be worth their weight in gold, and supplement other apparatus that may fail.

However, the writer's suggestion includes regular testing of the top sludge by withdrawal in quantity, and if warranted, a considerable removal of top sludge before it has degraded to a consistency that is difficult to handle hydraulically. The withdrawal facilities supply a means for large-scale testing of top-sludge character. Any experienced operator can determine on sight an approach toward dangerous conditions and the need for a drastic removal when he is given the opportunity to see top sludge in quantity and its flowing consistency.

Top sludge removal

Furthermore there are cases where the necessity for top sludge removal has resulted from no lack of efficiency in tank operation but from a local industrial waste. In the case of one plant where cannery wastes, without pretreatment, were discharged to the sewage works, a thick layer of pumpkin seeds, immune to digestion, produced a thick top sludge that required removal. At the same plant the writer has seen peas in the digested sludge that were unaffected as to color or deterioration. Of course these wastes, when mashed or ground, would be susceptible to normal digestion and would not appear as top sludge.

These citations serve to illustrate an initial condition resulting from some special waste which, in the first instance, require removal; in such cases a removal system that does not require dewatering or bypassing of the digestion tank is invaluable.

The value of recirculation of top sludge also is not to be ignored, even under normal conditions. This circulation would remove chilled material and replace it with warmer sludge from the lower levels of the tank, and in the process of circulation add necessary heat to the top sludge withdrawn.

Operating data on the application of radiant heating to sludge tanks, suggested by Mr. Leclercq, would be of interest. Such a plan would provide unquestioned support for the piping as well as avoid outside caking of sludge that occurs on exposed heating coils.

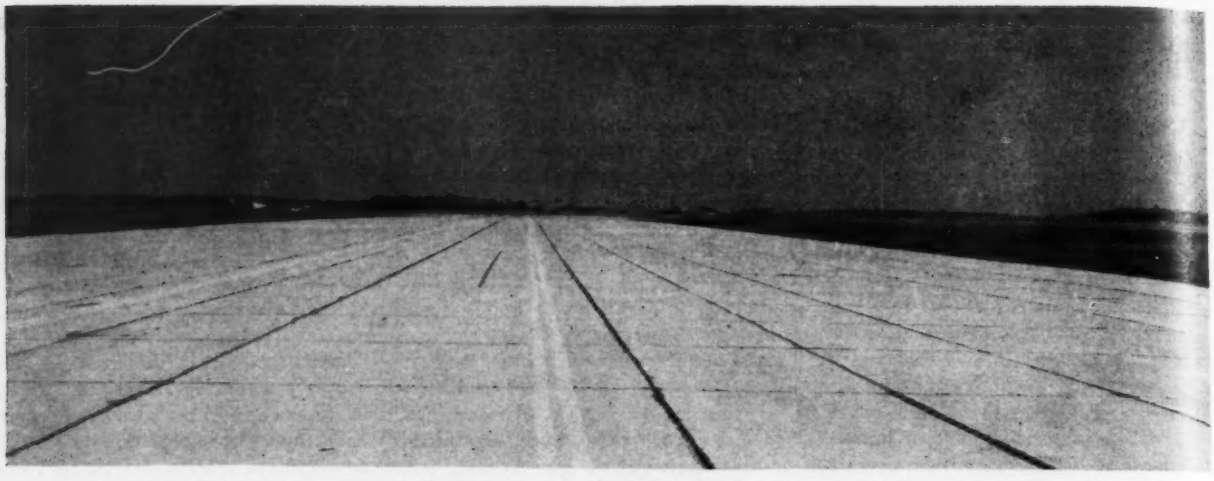


Fig. 1. Three-year old concrete runways at Bunker Hill Naval Air Station show no damage from freezing and thawing.

Durability of Concrete at an Airfield

***Contents in Brief**—An insufficient quantity of fines in sand aggregate for concrete pavement at a Naval airfield in Indiana required the addition of a cement-dispersing agent to lubricate the mix properly. Alternate freezing and thawing during the past three winters has caused no noticeable deterioration of the resulting concrete, nor has the application of calcium and sodium chlorides which were used extensively on portions of the pavement.*

THREE SEVERE WINTERS with their several cycles of alternate freezing and thawing have left no marked effect on the concrete paved runways, taxiways and aprons of the Bunker Hill Naval Air Station, near Peru, Ind. Neither has the application of calcium and sodium chlorides, employed as de-icing agents on the main service road and over portions of the warm-up aprons, caused any noticeable scaling or other deterioration of the concrete.

Credit for this durability of the pavement is attributed to the use of a cement-dispersing agent which was added to the cement used in the concrete. Although no de-icing agent was used on the runways or taxiways, flaked chlorides of sodium and calcium were extensively employed to keep ice from forming adjacent to four 500-ft. long open steel grid drains built into the two warm-up aprons. These chlorides also were applied liberally on a 200-ft. length of a concrete paved roadway just inside the main entrance to the airfield, as an aid to traffic which reached a maximum of 500 cars per day. Both chlorides were applied by hand shoveling.

Bunker Hill Air Station, one of the Navy's primary training fields, was paved in 1942. All runways, taxiways and aprons were completed before cold weather, but some of the concrete service roads were not finished until after freezing weather had set in. Although these roads were protected by burlap, canvas and dirt, some were subjected to light freezing before becoming properly cured. Consequently, close inspection discloses some deterioration of their wearing surface. This, however, was unlike scaling caused by alternate freezing or thawing.

Lubrication agent needed

Although a durable and scale-resistant concrete was of paramount importance for this airfield, the decision to use a cement-dispersing agent resulted from the lack of sufficient fines in the sand aggregate to give a properly lubricated, plastic mix.

Navy specifications required that: 95 to 100 percent of the sand used in making the concrete should pass a No. 4 mesh; 45 to 80 percent should pass a No. 16 mesh; 5 to 30 percent should pass a No. 50 mesh and from 0 to 8 percent should pass a No. 100 mesh screen. Actually only about 2 percent of the sand available for this work passed a 100-mesh screen. Thus it was deemed necessary that a lubricating agent be added to the cement in the form of a cement-dispersing admixture. This admixture (Pozzolith) was added at the mixer in the rate of 1 lb. per bag of cement.

All concrete paving on the job was mixed in the proportions of 1 part cement to 1.59 parts sand and 2.59 parts gravel, by volume. This mix required five bags of cement per cubic yard. With the specific gravity of sand and gravel being 2.58 and 2.65, respectively, the mix contained 5 bags of cement, 1,280 lb. of sand, 2,145 lb. of gravel and 5 lb. of the cement-dispersing agent. It produced a concrete weighing 152 lb. per cubic foot. Average slump of the mix was 2½ in., using a water-cement ratio of 5½.

Specifications No. 4 *Y d* of the Navy Department, Bureau of Yards and Docks, required the concrete to be class *F*-2, with a 3,500-psi. compressive strength at 28 days. Actually, the concrete averaged 3,340 psi. at 7 days and 4,200 psi. at 28 days. The con-

crete was cured with a membraneous curing compound. All pavement was placed with pavers and finished with ordinary finishing machines to give it a reasonably non-skid surface. It was not compacted except for a small amount of vibration adjacent to the side forms, using portable vibrators.

Paved runways, taxiways and aprons are 8 in. thick, on a compacted clay-loam subgrade. The pavement was placed in 20-ft. wide strips, with 1-in. bituminous asphalt expansion joints spaced 120 ft. each way and contraction joints spaced at 20-ft. intervals along the strips. A contraction joint formed with a "ribbon" machine also extends down the center of each strip of pavement. No reinforcement was used in the pavement except short pieces of ¾-in. rods and flat steel bars which serve as load-transfer elements across the expansion joints. Parallel strips of pavement were keyed together by tongue-and-groove joints.

This arrangement of joints resulted in a pavement sufficiently flexible to avoid uncontrolled cracking under the impact of planes landing or due to settlement of the subgrade. Contraction joints have opened as anticipated in the design of the slabs and they have been sealed with liquid asphalt.

Expansion joint maintenance

During the past three summers the bituminous asphalt expansion joint filler has extruded progressively, requiring it to be cut back four different times. Cutting of this filler is done with a specially built steel-frame sled which slides on top of the pavement and is pulled by a small rubber-tired tractor. Two workmen ride the sled to provide sufficient weight for the cutting blade to cut off all extruded filler flush with the top of the pavement. A re-shaped scarifier tooth built into the rear of the sled cuts the bituminous filler about ½-in. below the top of pavement.

Some 220,000 bbl. of cement went into the construction of the runways, taxiways and warm-up aprons. This represents 176,000 cu. yd. of concrete, which required 440 tons of the cement-dispersing admixture.

Bunker Hill Air Station has four runways, each 200 ft. wide by 5,000 ft. long; two warm-up aprons, the largest of which is 500 ft. wide by 900 ft. long, and two 100-ft. wide taxiways leading to the runways. In addition to the concrete pavement, the field has a 2,500 x 2,500-ft. landing mat made of 1-in. bituminous asphalt surfacing on a 6-in. stabilized soil-cement base.

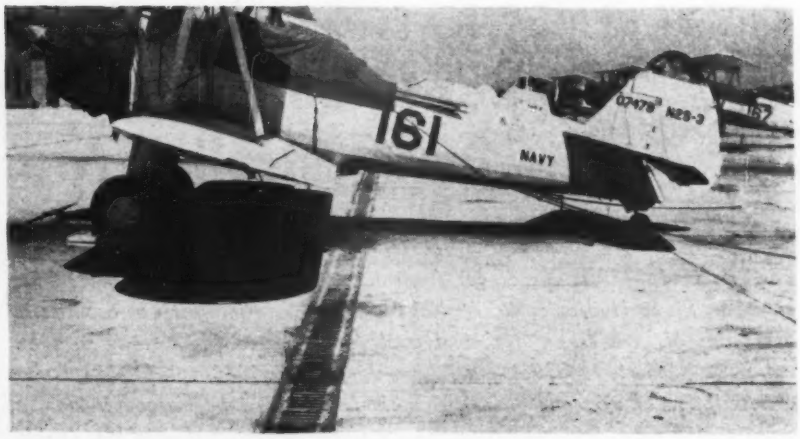


Fig. 2. Frequent applications of calcium and sodium chlorides as de-icing agents along the apron drains caused no apparent scaling of the adjacent concrete.

Fig. 3. Stop-and-go traffic at the main entrance to the airfield caused some abrasion of the concrete pavement.

Despite the comparatively heavy snowfall during the past three winters, this training field was kept in continuous operation except for a few days during the heaviest storms.

In general, snow was removed from the runways and taxiways by collecting it into windrows with light trucks equipped with one-way plows, loading it into trucks and hauling it away. Snow removal continued 24 hours per day when necessary. Due to the lack of hangar space many of the training planes were stored throughout the winter on the warm-up aprons. This aggravated the snow removal problem. Snow drifting around these planes necessitated the liberal use of calcium and sodium chlorides along the open-grid drains built into the concrete paved aprons.

As much of the snow as possible on the apron was removed by plowing and hauling, but during severe storms considerable hand shoveling was needed to keep the aprons in operation. During icy weather considerable amounts of sand and cinders were used on the taxiways.

All maintenance of the Bunker Hill Naval Air Station is under the supervision of Comdr. B. O. Roessler, public works officer, reporting to Capt. E. T. Neale, commanding officer. Burr E. Merrifield, at present, quarterman, public works, was chief naval inspector during construction of the airfield. Lieut. Comdr. H. H. Holmberg was in charge of construction, while the prime contractors were J. L. Simmons, Indianapolis, and the United Construction Co., Winona, Minn.

Moments Computed Graphically by Australian Method

***Editor's Note**—From one of our Australian readers, Arthur J. Keeble, office engineer, Kiewa Hydroelectric Works, Victoria, whose interest was aroused by our series of articles on graphical analysis of beams (ENR, May 4, 1944, vol. p. 659, June 1, 1944, vol. p. 802, and January 25, 1945, vol. p. 135), comes a description of a unique graphical method originated by his countryman, E. Saunders, 35 years ago. The present form of the method is due to Mr. Keeble, from whose notes the following is abstracted. Avoiding the conventional force, ray and equilibrium polygons, the Australian system is based on bending moment triangles for cantilever loading. From the cantilever moment it is a simple step to the diagram for simple supports, and by an extension of the method, using characteristic points, fixed-end and continuous beams can be solved.*

IN AUSTRALIA a graphical method for determining bending moments in beams has been gaining favor. Using bending moment triangles for cantilever loading, this procedure provides a direct solution to simple, fixed-end and continuous beam problems without the necessity of making auxiliary sketches, such as the force and ray diagrams in the conventional procedure. Because of the use of the cantilever theory, the concepts involved in the Australian system are simple.

In a cantilever the bending moment is the product of the force and its distance from the point of support. Thus, the bending moment is directly proportional to the distance from the force. The geometric construction utilizing this principle is the crux of the Australian method.

For example, triangle 1-1a-1b, Fig. 1, represents the moment diagram of load 1 cantilevered from 1a, a point chosen at an arbitrary distance *d* from 1. The vertical ordinate to any point on 1-1b, or 1-1b produced, represents to some scale the moment at that point due to load 1. Also, 2d-2b-2c represents the moment diagram of load 2 about 2a, a point *d* distance from 2, and, as in the case of load 1, the moment at any point is given by the vertical ordinate of the triangle. Similarly, the triangle 3d-3b-3c is the moment diagram for load 3. It should be noted that 2d is the intersection of line 1-1b with the line of action of force 2. Similarly, 3d is the point of intersection of line 2d-2c with the line of action of force 3.

This construction yields the same result as if the moment diagrams for each of the four loads were all plotted on the horizontal line AB and ordinates algebraically added. Any vertical ordinate to the traverse 1-2d-3d-4d-4c represents the bending moment due to the four loads acting on a beam cantilevered from a point to the left of the loads.

Use of half scale

The procedure followed in Fig. 1 was to set off 1a on AB at an arbitrary distance *d* from 1. Also, 2a and 3a are the same distance *d* from points 2 and 3, respectively. However, if point 4a had been placed at the same distance from point 4, it would have fallen off the sheet. Therefore, it was located only $\frac{1}{2}$ *d* from point 4.

At 1a a vertical, 1a-1b, was drawn in a downward direction to represent to a suitable scale load 1, 5 tons. The line joining 1 and 1b was extended to intersect a vertical through 2a at 2b. From 2b, however, the 4-ton upward force was laid out in an upward direction, but to the same scale as before. Again, at 3b the 3-ton load was plotted downward to that scale. On the other hand, at 4b, to counteract the effect of locating 4a only $\frac{1}{2}$ *d* from 4, only $\frac{1}{2}$ of force 4 was plotted.

If the last line, 4c-4d, is extended to its intersection at X with line AB, the center of gravity of the four loads is located at X. A single force of 8 tons—the algebraic sum of the loads—applied at X would produce the same moment at a point outside the load system as would the four loads acting in their respective positions. Consequently, at point Xa, *d* distance from X, the ordinate Xa-Xb to 4c-4d should be equal to 8 tons on the same scale as was used for 1a-1b. This is a check on the construction. (Actually, in Fig. 1, X-Xa and Xa-Xb were plotted to half-scale.)

If AB represents a simple beam, for equilibrium conditions a reaction must be introduced at A such that the counter-clockwise moment of this force about B is equal to the combined clockwise moments of the loads about the same point. This counter-clockwise moment is represented by the triangle A-B-4f. By subtracting from this triangle the cantilever moment diagram of the load system, the remaining figure A-1-2d-3d-4d-4f is the bending moment diagram for a span simply supported at A and B and acted on by loads 1, 2, 3 and 4. All moments are measured by vertical ordinates.

Considering only the resultant of the loads acting at X, the moment diagram about B as a cantilever is the triangle X-B-4f. The triangle 4f-X-A is the moment diagram for the resultant as a load on beam AB. A study of this triangle indicates that if any points other than A and B are selected as supports, the points 4d, 3d, 2d and 1 do not alter. Neither is there any alteration in the slope of the lines 4f-X and XA. These lines are called ray lines and are tangential to the moment diagram.

If other support points are selected, the only change that occurs is in the position of the base line 4f-A, which joins the points of intersection of the ray lines and the verticals through the supports. The immutability of the cantilever diagram may be used to good advantage in determining the maximum bending moment due to a group of moving loads.

The scale by which bending moment ordinates are measured can be explained as follows: Let AB be the beam to a scale of q in. per in. Hence, the distance d would measure dq inches. If the loads were laid out to the scale of p tons per in., then the bending moment would be represented by measuring to a scale of pdq in.-tons per in.

For example, assume a load of 4 tons acting at the end of a cantilever 10 ft. long. If in the construction of the bending moment diagram d is 2 in., the linear scale 60 in. per in. and the load scale 2 tons per in., the bending moment scale, pdq, equals 2 times 2 times 60, or 240 in.-tons per in. Thus, the moment at the support of the 10-ft. cantilever is obtained by measuring the triangular ordinate there using this moment scale, and since the ordinate is 2 in. long, the moment at the support is 2×240, or 480 in.-tons. Similarly, measuring the ordinate at any other point to the same scale will give the bending moment at that point.

If any particular bending moment scale is desired, the proper d can be chosen by selecting suitable p and q scales and equating pdq to the desired scale. Thus,

$$d = \frac{B.M.\ scale.}{pq}$$

Assuming the desired bending moment scale to be 500 tons per in., the linear scale 60 in. per in. and the load scale 2 tons per in., then $d = 500/(60 \times 2) = 4.16$ in.

For convenience in plotting, a length scale should be used that is as small as is consistent with ability to plot the exact position of loads. The setting-off distance d should be as short as convenient, but for the sake of accuracy never shorter than the overall distance between the first and last load or the first load and far end of beam. However, a load scale as large as will be workable should be used.

Loads split into two groups

In order to use a shorter d and to obtain the bending moment diagram to a larger scale, the construction illustrated in Fig. 2 may be followed. The five loads on beam AB are divided into two groups—1, 2 and 3 on the left, 4 and 5 on the right. For each of the groups the procedure is the same as the one illustrated in Fig. 1.

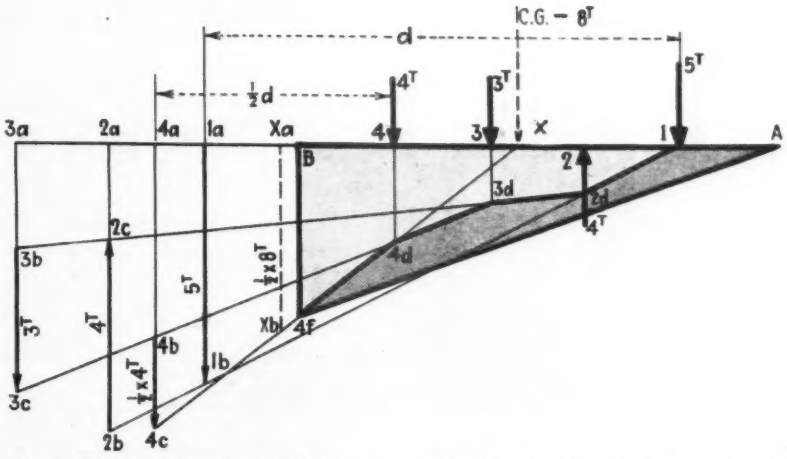


Fig. 1. The bending moment diagram for a simple beam is obtained graphically through the use of a series of moment triangles for cantilever loading.

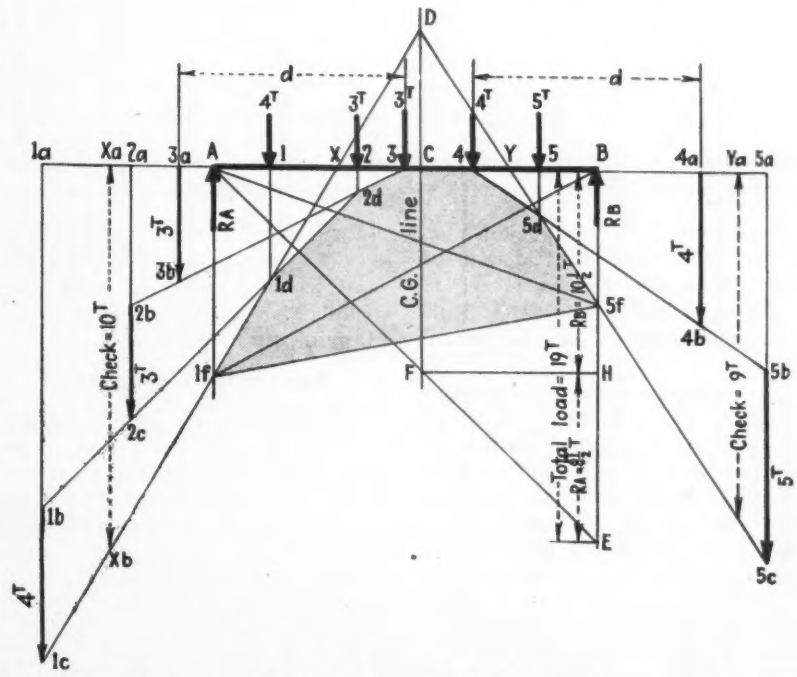


Fig. 2. To condense the work, the loads are divided into two groups, each of which are treated as in Fig. 1, and the resulting moment diagrams are combined.

If X and Y are the centroids of the load groups, the final line 1c-X, or 1c-X produced, represents the moment due to loads 1, 2 and 3 and the final line 5c-Y represents the moment of the combined loads 4 and 5. These lines intersect at D. Then C—the projection of D on AB—is a point about which the moment for the combined loads 1, 2 and 3 is equal to the moment of the combined loads 4 and 5. Thus C is the centroid of the resultants at X and Y and, consequently, the centroid of all the loads, the magnitude of the resultant being the algebraic sum of the loads—19 tons.

In Fig. 2, let 1f be the intersection of the left hand ray line and the vertical through support A. Also, let 5f be the intersection of the right hand ray line and the vertical through support B. If only loads 1, 2 and 3 act on simply supported beam AB, then polygon 1f-1d-2d-3-B is the bending moment diagram. Similarly, polygon 5f-5d-4-A is the bending moment diagram for loads 4 and 5. By adding the vertical ordinates of the two diagrams,

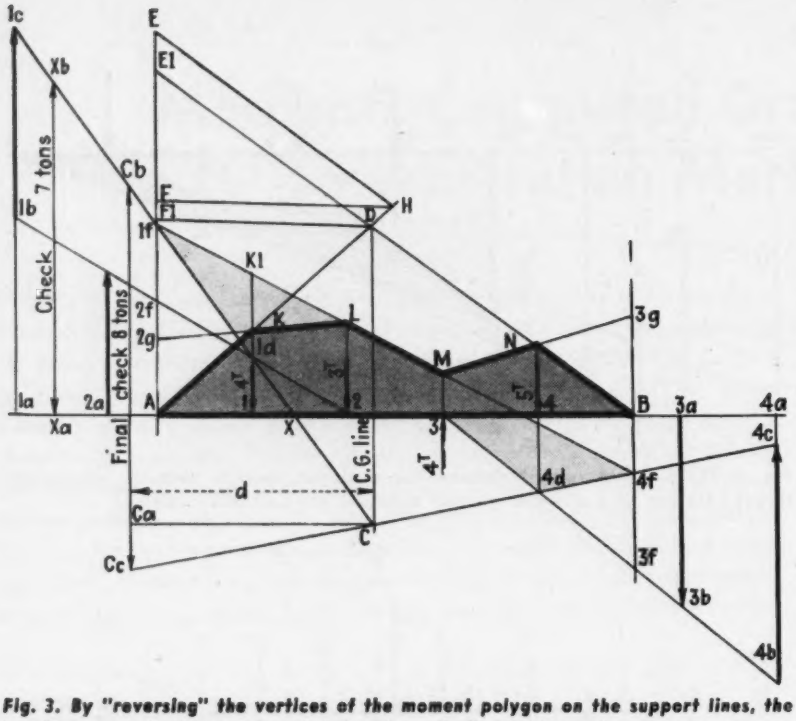


Fig. 3. By "reversing" the vertices of the moment polygon on the support lines, the bending moment diagram is rotated onto a horizontal base line.

the moment due to the whole loading system is obtained. Thus addition can be performed by joining 1f and 5f, making polygon 1f-1d-2d-3-4-5d-5f the bending moment diagram for the five loads.

As noted previously, if the points of support, A and B, are shifted, base line 1f-5f takes up its new position and the remaining boundaries of the bending moment diagram are unaltered. Also, the ray line 1f-D and 5f-D are unchanged. It should also be noted, that these ray lines intersect on the line of action of the resultant of the load and 1f-D-5f is the bending moment diagram for the resultant.

How reactions are plotted

To find the reactions at A and B, Fig. 2, BE is set off to represent the algebraic sum of the loads (19 tons) and EA is drawn, intersecting the line of action of the resultant at F. If, through F, a parallel to AB is drawn, intersecting the support line at H, then BH represents the reaction at B and HE the reaction at A.

The construction for finding the reactions can be proved as follows: Triangles ACF and ABE are similar, so that AC/CF = AB/BE. Therefore, noting that CF = BH, BE (the total load) multiplied by AC (distance between support A and centroid) is equal to the product of BH and AB (span length). Since this is also the condition for equilibrium of the beam, BH must be the reaction at B.

Base rotated to horizontal

If it is desired to plot the moment diagram on a horizontal base, as is conventional, the procedure illustrated in Fig. 3 can be followed. The beam and loads are the same as those considered in Fig. 1 but the loads are divided as in Fig. 2, and the construction is varied slightly. In Fig. 3, in order to obtain the moment diagram above AB, loads are plotted in the direction opposite to that in which they act.

As in Fig. 2, the points of intersection of rays and support lines are joined, and polygon 1f-1d-2-3-4d-4f is the bending moment diagram. The next step is to bring this onto a horizontal base AB. It should be noted that the portion 2-3 is already on this base and will not need to be altered.

Using a paper straightedge, points A, 2f and 1f on AE are reversed, so that A is at 1f, 2f is at 2g and 1f is at A. Likewise, B, 3f and 4f are reversed, placing B at 4f, 3f at 3g and 4f at B. Consequently, the vertical ordinate of triangle 1f-L-2g are equal to those of triangle 2f-2-A and trapezoid K1-L-2-1d can be replaced by trapezoid K-L-2-1. Similarly, since K1-1d equals K-1, triangle 1f-K1-1d can be replaced by triangle A-K-1. By similar reasoning, M-4f-4d-3 can be replaced by M-N-B-3. Then, as required, the bending moment diagram is A-K-L-M-N-B, constructed on AB.

To determine the reactions the procedure is as follows: AE is laid out to represent the algebraic sum of the loads (8 tons) to the *p* scale. Through E a line is drawn parallel to ray BD, intersecting ray AD at H. A line through H parallel to AB intersects AE at F. Then, AF measured to the *p* scale is the reaction at A, and EF scales the reaction at B.

This can be proved by producing BD to meet the support line at E1 and drawing a line through D parallel to AB, intersecting AE at F1. If A-E1 represents the total load to some scale, then, according to the construction used in Fig. 2, A-F1 would represent the reaction at A to the same scale. Since AE represents the load to the known scale, AF is, from similar triangles, the reaction at A to the same scale.

Continuous beams solved

The bending moment diagram for a continuous beam can be divided into two components—a simple beam polygon and a negative moment trapezoid. Consequently, by an extension of the procedure just established, continuous beams may be analyzed graphically. For this purpose the use of characteristic points is very convenient.

The principle involved is that the slopes at the ends of a simply supported span are represented by the ordinates of the negative moment trapezoid at the characteristic points. These points are located in such positions that any line drawn through either one satisfies the condition for fixing the adjacent beam end against rotation. Also, a line through both points fixes both ends of the span.

After the bending moment diagrams for a continuous beam are plotted on each of the spans, considering them as simply supported, and the characteristic points located, the object is to draw a new base line that makes the slope of the deflection curve at the supports the same for all spans joining there. This can be done using the principle of characteristic points.

Now Under Construction Is.....

South America's Biggest Water Supply Job

Edward J. Cleary
Executive Editor, Engineering News-Record

● *For more than a century Caracas, capital city of Venezuela, has been unable to keep pace with increasing water supply demands. To correct this situation a broad development project involving the construction of storage and diversion structures has been initiated, and designs are nearing completion for treatment plants and distribution system improvements. This article outlines accomplishments to date and describes some of the special problems involved in meeting the needs of a South American city whose population is nearly 400,000.*

South America's biggest water supply project now under construction, that for Caracas, Venezuela, is providing an opportunity for North American engineers and contractors to apply their skills in expediting the installation of facilities that are sorely needed in one of the most important capital cities south of the border.

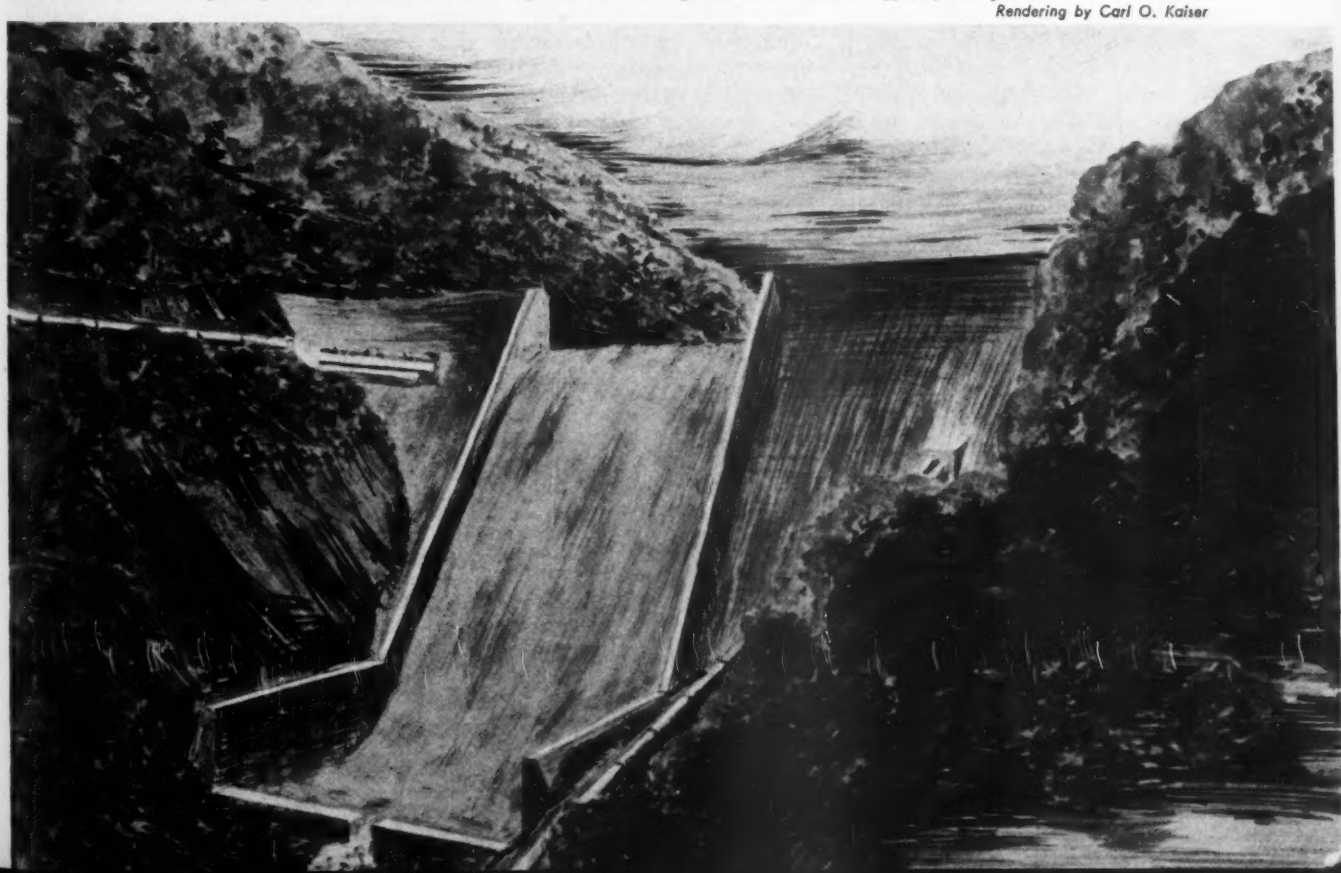
Contracts underway for supply works call for some $12 million of work, but the total cost of the project, to be built in successive stages, will probably be more than twice this amount. The project is being carried out under the direction of Venezuela's National Institute of Sanitary Works (Instituto Nacional de Obras Sanitarias), which has issued bonds to finance operations.

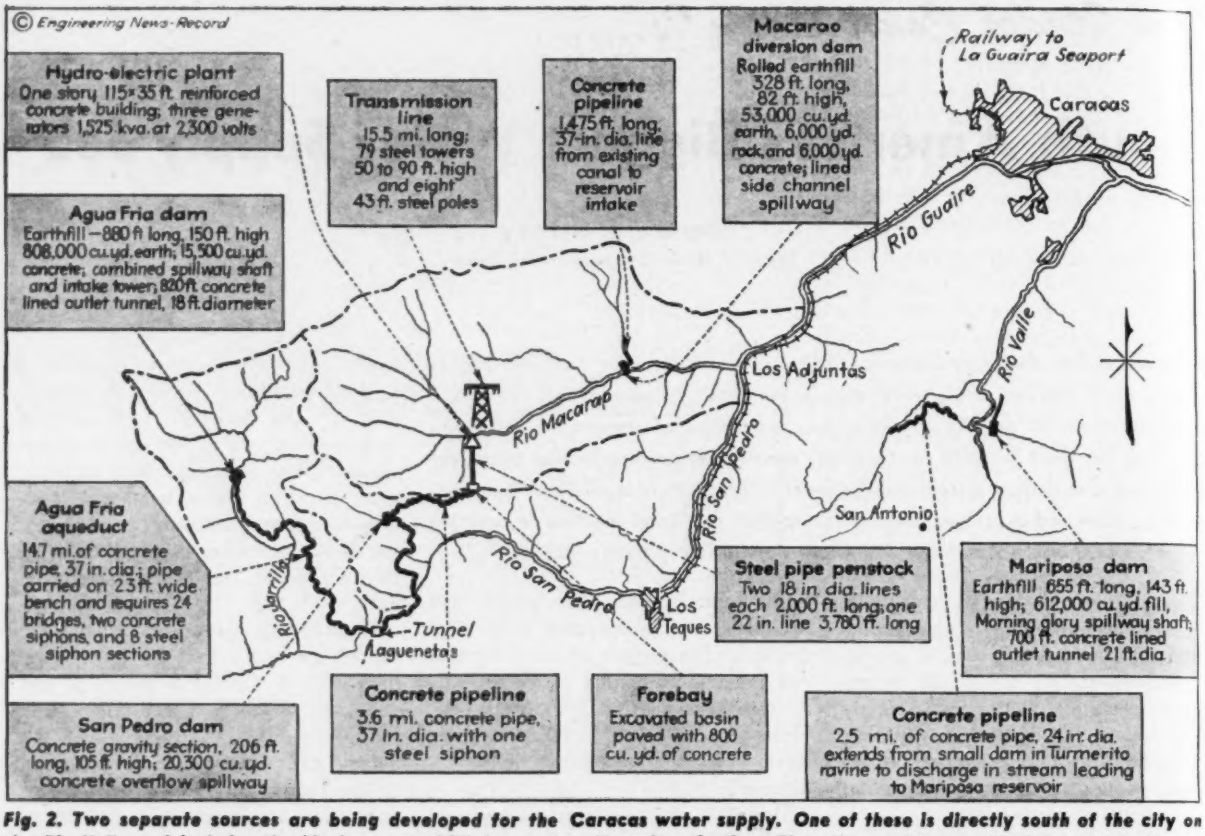
Design of the system, which is being handled by Parsons, Brinckerhoff, Hogan & MacDonald, New York consultants, has been under study by that firm since 1940. It posed a number of unusual problems relating to integration of new facilities with existing structures as well as the incorporation of provisions for progressive enlargement to meet future demands. Furthermore, it was necessary to predicate the design on rather scanty records of rainfall, stream runoff and other basic data.

Construction operations, which were started more than a year ago by the firm of S. J. Groves & Sons Co. and Johnson, Drake & Piper, Inc. (who jointly hold the contracts under the name of Compania Constructora Groves-Drake), were complicated initially by transportation difficulties, equipment shortages and other war restrictions. Despite these difficulties the work has been advanced to the

Fig. 1. Storage and flow regulation are provided by San Pedro dam, a key structure in the Caracas water supply development. This concrete gravity dam, which is 206 ft. long and 150 ft. high, has an overflow type spillway

Rendering by Carl O. Kaiser

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Hydro-electric plant
One story 115×35 ft. reinforced concrete building; three generators 1,525 kva. at 2,300 volts
Transmission line
15.5 mi. long; 79 steel towers 50 to 90 ft. high and eight 43 ft. steel poles
Concrete pipeline
1,475 ft. long, 37-in. dia. line from existing canal to reservoir intake
Macarao diversion dam
Rolled earthfill 328 ft. long, 82 ft. high, 53,000 cu. yd. earth, 6,000 yd. rock, and 6,000 yd. concrete; lined side channel spillway
Railway to La Guaira Seaport
Caracas
Agua Fria dam
Earthfill—880 ft long, 150 ft. high 808,000 cu. yd. earth; 15,500 cu. yd. concrete; combined spillway shaft and intake tower; 820 ft. concrete lined outlet tunnel, 18 ft. diameter
Rio Guaire
Rio Valle
Los Adjuntas
Rio Macarao
Rio San Pedro
San Antonio
Agua Fria aqueduct
14.7 mi. of concrete pipe, 37 in. dia.; pipe carried on 2.3 ft. wide bench and requires 24 bridges, two concrete siphons, and 8 steel siphon sections
Rio Jarillo
Tunnel
Laguenetas
Rio San Pedro
Steel pipe penstock
Two 18 in. dia. lines each 2,000 ft. long; one 22 in. line 3,780 ft. long
Los Teques
Mariposa dam
Earthfill 655 ft. long, 143 ft. high; 612,000 cu. yd. fill, Morning glory spillway shaft; 700 ft. concrete lined outlet tunnel 21 ft. dia.
San Pedro dam
Concrete gravity section, 206 ft. long, 105 ft. high; 20,300 cu. yd. concrete overflow spillway
Concrete pipeline
3.6 mi. concrete pipe, 37 in. dia. with one steel siphon
Forebay
Excavated basin paved with 800 cu. yd. of concrete
Concrete pipeline
2.5 mi. of concrete pipe, 24 in. dia. extends from small dam in Turmerito ravine to discharge in stream leading to Mariposa reservoir

Fig. 2. Two separate sources are being developed for the Caracas water supply. One of these is directly south of the city on the Rio Valle and includes the Mariposa earthfill dam and a diversion pipeline. The other and larger development, southwest of the city, taps the watersheds of the Agua Fria, San Pedro and the Macarao rivers. Major structures are captioned.

point where completion is anticipated in 1947. A subcontract for the manufacture of some 21 miles of reinforced concrete pressure pipe is held by the Lock Joint Pipe Co. of Ampere, N. J.

Features of the Caracas water supply include the construction of major storage and diversion works, major replacement and extension of virtually the entire distribution system facilities, and the installation of at least two treatment plants. Present work, however, is confined to the storage and diversion facilities along with the development of some hydro power. Principal features of this work are shown in Fig. 2.

It will be noticed from Fig. 2 that two separate sources are being developed. One of these, directly south of the city on the Rio Valle, includes the construction of the 612,000 cu.yd. Mariposa earthfill dam, and a 2.5 mile concrete pipeline; the latter will divert water from an adjacent watershed into the Mariposa reservoir. The safe water supply yield is 6.8 mgd. with probable peaks of 13.7 mgd.

The other and larger development, southwest of the city, includes three dams, a 37 in. diameter concrete pipeline totaling 18.5 miles, a concrete-lined forebay, a steel pipe penstock. construction of a hydroelectric plant and the installation of 15.5 miles of steel tower transmission line. The major streams involved are the Rio Agua Fria (a branch of Rio Jarillo), Rio San Pedro and Rio Macarao. The safe water supply yield from this development is 17 mgd.; in addition the annual power production will be 8,660,000 kw.-hr.

Development of Rio Agua Fria

Conception and execution of the southwest, or Agua Fria, development, as it is known, called for bold planning. The terrain of this area is extremely rugged with elevations ranging up to 7,000 ft. above sea level. The area is near the top of the southern slope of the coast range of mountains that rise abruptly from the Caribbean Sea, and only about 10 miles from the coast. Embroidered with streams that flow south and east, the high altitude watershed of the area may be characterized as a series of steep, catchment areas with relatively little vegetation.

Rainfall records at Victoria, located on Rio Agua Fria upstream from the reservoir site, during the years 1901-1941, show the following extremes in any year: Minimum total rainfall in wet season (7 mo., May to December) of 21 in.; maximum total in wet season of 61 in.; minimum total in dry season (5 mo.) of 0.0 in.; and maximum total in dry season of 13 in.

However, condensation from clouds on the precipitous watersheds occurs at an appreciable rate during the entire year with the net result that the streams show comparatively high flows in the dry season. The minimum flows are from 50 to 60 percent of the mean flows.

Consequently, to equalize the supply for both power and water requirements, relatively small storage capacities are required. This is a fortunate condition, because in such mountainous terrain only a few reservoir sites of limited capacity were available. This led to the decision to build three

dams, each reservoir on a major watershed and interconnected.

Furthest from the city is the Agua Fria dam with a flow line elevation of 5,620 ft. This dam is the key structure for the southwest supply system because it provides for completed regulation of not only the flow from the Agua Fria, San Pedro and Macarao rivers, but also from the Upper Western Tuy, which eventually will be diverted into the reservoir by pipeline. Operation of the reservoir will have the unique effect of producing maximum flows and power generation at the Macarao hydro station during the dry season, and minimum flows during the rainy season. In this manner the electrical energy requirements will be satisfied for operation of the pumping stations in the city distribution system, which demands are highest during the dry season, and surplus dry season energy of maximum value will be available for sale.

Design of the Agua Fria dam to take full advantage of the economic value of this reservoir was developed with the consulting advice of Joel D. Justin.

Located on a watershed which drains south, storage from Agua Fria reservoir will be diverted through a 37-in. pipeline to empty into the San Pedro reservoir. In order to accomplish this, the pipeline follows a tortuous route for 14.7 miles; it is carried along the sides of ravines on a 23-ft. bench, passes through natural gorges and across streams, and at one place will go through a 400-ft. tunnel before reaching the reservoir outlet.

The San Pedro reservoir serves as a balancing reservoir and also to gather flow from the upper reaches of the Rio San Pedro. Provision is made at this reservoir to bypass the entire flow from the Agua Fria pipeline directly into the outgoing pipeline that leads to the power-house forebay.

The forebay, which is simply a paved basin excavated at the top of the ridge above the power-house (capacity of about 370,000 cu. ft.), will be served by a pipeline of 3.6 miles leading from San Pedro reservoir. At this point advantage is taken of a drop of 1,430 ft. for the production of power. From the forebay, a penstock consisting of two 18 in. diameter steel pipes (2,000 ft. long) connecting to one 22-in. diameter pipe (3,780 ft. long), leads to the hydro-electric plant.

Design of the power plant and penstock was complicated by the fact that the government desired to use certain equipment which had been acquired through the purchase of water rights on the Rio Agua Fria. The party that owned these rights had completed plans for a hydroelectric plant on the Agua Fria, and the equipment had been purchased and delivered in Venezuela although the plant was never constructed. The problem, therefore, was to adapt this equipment to the new location where it would have to operate on a considerably higher head and provide for a greater water capacity than originally contemplated.

PRINCIPAL TYPES OF EQUIPMENT SHIPPED FROM THE U. S.

12 Cranes, shovels and draglines
12 Air compressors (cap. up to 500 cfs)
5 Mixers (10, 14 and 28-S-sizes)
82 Trucks (1½ to 10-ton)
32 Tractors, scrapers and rollers
14 Truck trailers (10-35 ton)
6 Welding outfits
20 Pumps
Complete equipment for establishment of machine shop, carpenter shop, rock-crushing and batching facilities.

The solution as regards the penstock was to use the original 18-in. penstock pipe in the upper portion of the new location where the head did not exceed the head of the original plant. By placing the 18-in. pipes in parallel they were able to furnish the required increase in water capacity. For the portion of the new penstock location subject to higher heads a new 22-in. pipe was ordered.

The original power plant was to be furnished with two horizontal axis Pelton wheel units of 795 hp. capacity. It was found possible to convert each of these wheels to operate under the higher head of the new installation by ordering new bucket-wheels. One of the units was changed by connecting the two original generators to the wheel shaft as these generators had about the same combined capacity as the Pelton unit would have under the new head. The second unit was furnished with a single new generator of the required capacity. The third unit will consist of a new Pelton wheel with a new generator.

Each of the units has a capacity of 1,670 hp. when discharging 12.4 cfs. at a net head of 1,405 ft. Bypassing of water when the water supply requirements exceed power demands will be accomplished by means of the jet-deflector of the Pelton unit.

Water discharged from the Pelton wheels of the power plant continues on down the Rio Macarao to the Macarao diversion dam. From this point, which is just above the site of an intake for the existing Caracas supply, there is an aqueduct as well as an 18-in dia. pipeline leading to the city.

Construction activities

One of the first and major hurdles in starting the work, according to officials of Compania Constructora Groves-Drake, was to secure shipping space, which was at a premium in Sep-

Fig. 3. Benching operations preparatory to the installation of a section of the Agua Fria aqueduct near La Guaetas. The 37 in. concrete pipeline is carried on a 23 ft bench, hewed out of the sides of hills and ravines.

tember 1944. Equally as difficult was the assembly of construction equipment, and the contractors had to content themselves with no less than 90 percent of used equipment. Since much of this varied in type, size and make, it was then necessary to build up an elaborate and diverse inventory of repair parts.

Virtually all construction materials for the work—such as cement, reinforcing and structural steel, metal pipe, wire, etc.—are being shipped from the United States. Sand and gravel are obtained locally. A partial listing of the quantities of materials shipped includes: 1,000 tons reinforcing steel; 800 tons of wire mesh; 200,000 bbls. cement; 1,000,000 b.f. lumber; 200 tons dynamite; 400 tons steel transmission towers; and 900 tons steel pipe.

To accommodate the material arriving at La Guiara, seaport for Caracas, warehousing facilities had to be installed, and eventually all of it must be transported over the 4,000-ft. coastal range of mountains by truck. There is an existing narrow gage railroad from the seaport to Caracas but the large volume of normal freight shipment precluded its use.

Over a considerable portion of the routes from Caracas to the various job sites, there were virtually no roads, and the first task of the contractor was to engage in an extensive access road-building program. Illustrating the lack of facilities are these notes from one of the field maps: "Los Adjuntos to hydro plant—13 kilometers; 6.5 km. bad dirt road 3 meters wide, impossible for trucks," and then there was this notation, "Los Teques to San Pedro dam—13.5 km., earth road, 3 meters wide, 20 percent maximum grade."

Further illustrating the difficulty of access were the experiences of the contractor's forces during the October rains when the nearest they could reach to the Agua Fria dam by truck was still 1½ hours by tractor from the site.

Thus far it is estimated that some 40 miles of road have been built by the contractor, and much of this requires almost continual maintenance in order that the roads are passable and free of slides.

To man the job some 125 engineers, technicians and equipment operators were sent from the United States. About 1,500 Venezuelan skilled and common laborers have been recruited. Skilled labor is not readily available and there is a general shortage of all kinds of labor in Venezuela. However, the construction labor is adaptable, apt and develops competence, states the contractor.

It is also pointed out, that the Venezuelan government has no restrictions on the number of Americans employed on the job, a situation that will be recognized to be in contrast to conditions in some other South American countries. Groves-Drake officials point out that it is the company's policy to utilize the services of Venezuelan citizens insofar as they are available and qualified, thus limiting the use of North Americans on the work.

To house the personnel, six camps have been built, and these have been provided with all facilities, including electric light, sewage disposal and water supply. Particular attention is paid to the latter, all water being subjected to treatment in mobile or portable units similar to those developed for American Army troop use.

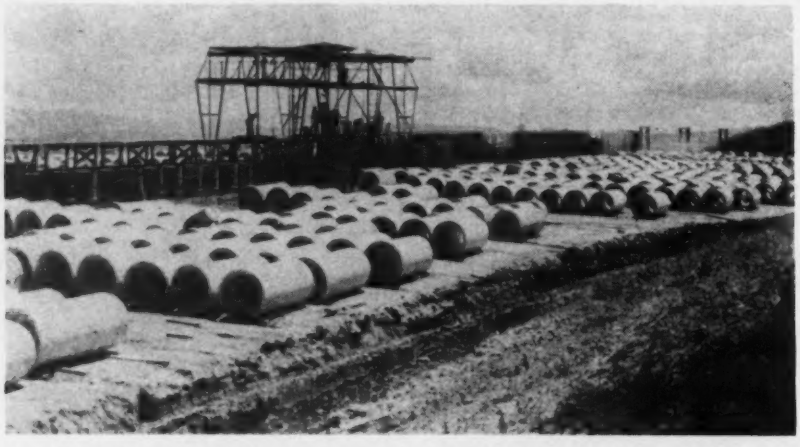


Fig. 4. Concrete pipe fabricating plant set up at La Guaetas by the Lock Joint Pipe Co., where production is in excess of 500 ft. per day. This 37-in. dia. pipe is cast in 8 and 4 ft. lengths, the latter being used for accommodation to the many turns in the aqueduct route. Because the aqueduct is virtually at grade and sustains only small pressure, the pipe is cast without the customary interior steel cylinder.

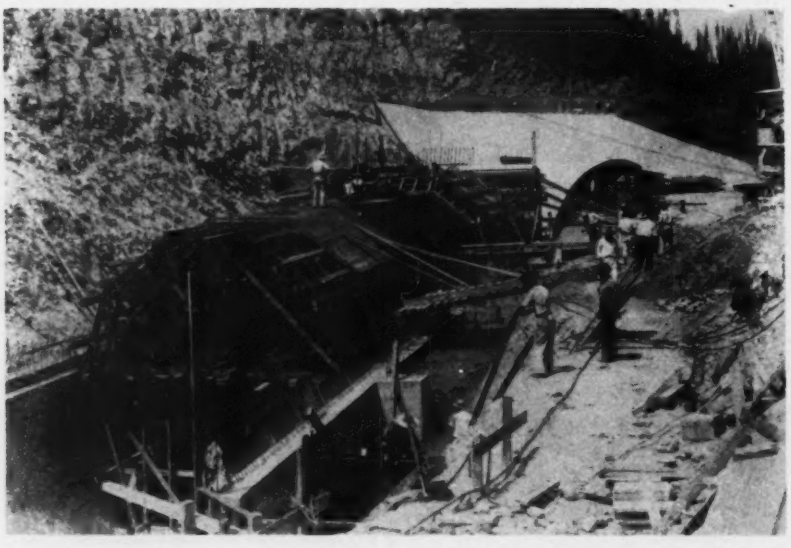


Fig. 5. Macarao dam is a rolled earthfill structure 328 ft. long and 82 ft. high. It is provided with a concrete spillway conduit, some construction details of which are shown here. The side channel concrete weir appears in the background.

Background of project

Records indicate that during the past century Caracas has continually lacked an adequate water supply, the population growth being much faster than the development of additional supplies.

WHO'S WHO ON THE CARACAS WATER SUPPLY WORK

Principal personnel concerned with the work, which is under the jurisdiction of Luis Lander, Minister of Public Works of Venezuela, are:

Instituto Nacional de Obras Sanitarias

Miguel Viloria Lugo	President
Diego B. Mejias	Vice President
Luis Wannoni Lander	Director
Oscar Augusto Machado	Director
Luis Cardenas Cardenas	Director

WATER SUPPLY PROJECT

Parsons, Brinckerhoff, Hogan & Macdonald

Gerald T. McCarthy Special Partner

New York Office

James R. Cook	Design Supervision
H. Alden Foster	Hydraulic Design
Edgar O. Marty	Electrical Design

Caracas Office

Harold L. Ohnmeis	Manager
James W. Barclay	Assistant Manager
Hjalmar Gericke	Chief Engineer

Compania Constructora Groves-Drake

New York Office

R. E. Ellingsen	Manager
Harvey W. Jones	Coordinator
Carl O. Kaiser	Engineer

Caracas Office

Francis Thomas	Project Manager
Edward L. Causey	Assistant Manager
E. P. McGahn	General Superintendent
Sydney Berliner	Chief Engineer
Edward Groves	Project Superintendent
R. J. Wellinghorst	Project Superintendent
Frank Laird	Project Superintendent

Lock Joint Pipe Co.

William Brand, Manager (Caracas Office)

WATER DISTRIBUTION PROJECT

Parsons, Brinckerhoff, Hogan & Macdonald

Caracas Office

G. Gale Dixon	Consultant
James R. Cook	Project Engineer
Gustavo Perez Guerra	Chief of Design

At the last census of 1941, the population was 341,400, an increase of 35 percent over the preceding five years. Today the population is estimated to be between 350,000 and 400,000. The available supply during the dry season from wells and surface sources is some 20 mgd., which is said to be not only inadequate but in many instances is not potable.

One of the earliest water supply improvements for Caracas occurred in 1870 when a 29-mile canal was dug from the city to the Rio Macarao. This unlined canal was not satisfactory because of water loss through leakage, and was abandoned in 1895 in favor of an 18 in. cast-iron pipeline. By 1908 the need for more water resulted in putting the canal back into service, and in 1917 it was lined and covered.

Following a severe drought in 1924-26, Thorndike Saville, a consulting engineer and now dean of the New York University College of Engineering, was invited to study the Caracas problem. He gave approval to a previous suggestion that a dam be built on the Rio Macarao but made the proviso that this would be justified only if additional supplies from other watersheds could be diverted to it. It will be noted that this principle has been adopted in the design of the present project.

Various other reports were made by Venezuelan engineers but little was accomplished aside from development of some additional groundwater in 1931. Reasons for this lack of action are obscure, but it might be recalled that in the 27-year period ending in 1935 the country was dominated by the dictator Juan Vicente Gomez. It is reported that Gomez had little interest in promoting public works, and he held a peculiar aversion toward sponsoring improvements in the city of Caracas, despite the fact that it was the capital.

Gomez died in 1935. Since that time Caracas has expanded rapidly and additional water has been sought from groundwater sources. However, shortages of water became increasingly acute and the lack of filtration and sterilization facilities are said to have left uncontrolled the communication of water-borne diseases.

Analysis of consumption demands

In reviewing the water supply needs of Caracas, Gerald T. McCarthy, special partner for Latin America of the Parsons, Brinckerhoff, Hogan & MacDonald firm, has this to say:

The principal demands upon the Caracas water supply are for (1) domestic consumption; (2) municipal use; (3) industrial and commercial use; (4) wasted leakage; and (5) irrigation of lawns.

Domestic consumption was studied in two broad classes: First, that part of the population being served by individual house connections and, second, those served by public fountains.

There are, at the present time, over 500 water meters installed in individual house connections from which basic data have been obtained for the determination of the per capita consumption. The experience of other tropical cities, particularly Cali, Colombia, and Maracaibo, Venezuela (where a 95 percent metered system is in operation), also provided good data for determining this amount.

From a study of these data it is estimated that the per capita consumption of people served by house connections will be about 85 gallons a day. The following table shows how the various uses contribute to this figure:

Use	G.p.d. per capita
1. Domestic (including all household uses except lawn irrigation)	53.8
2. Municipal (including public buildings, street and sewer cleaning and fire fighting)	5.8
3. Industrial and commercial	8.8
4. Waste and leaks	16.6

Per capita consumption of people served by public fountains in the suburbs is estimated to be 16 gallons per day.

Use of water for irrigation of lawns and gardens is an appreciable item. It is estimated that during the normal dry season, from December to April, it is about 0.78 gallons per square yard. On this basis irrigation uses account for about 14.4 percent of the total demand.

Daily peak demands are expected to be about 100 percent in excess of the average daily demand. Peak requirements over periods of two or three weeks are expected to reach approximately 25 percent in excess of average daily demand, according to Mr. McCarthy.

Two large purification plants are now being designed by the engineering division of the Instituto Nacional de Obras Sanitarias, one at El Valle to treat, filter and chlorinate the supply from the Rio Valle, and the other at Las Adjuntas to treat, filter and chlorinate the supply from the Agua Fria, San Pedro and Macarao rivers.

Additional distribution facilities are being designed by Parsons, Brinckerhoff, Hogan and Macdonald, plans and specifications for which will be completed by April. Principal features of this work are 45 miles of pressure supply mains varying from 20 to 42 in. in diameter, 137 miles of distribution mains, several reinforced concrete side-hill distribution reservoirs with a total capacity of 19 mg. and some pumping stations. It is expected that construction of these works will be undertaken in the near future.

From Field and Office

WORKING PROBLEMS AND TIME-SAVING METHODS FOR ENGINEERS AND CONTRACTORS

Formula for Use in Moment of Inertia Problems

Often in structural design the moment of inertia of a group of aggregates—rivets or piles, for example—must be computed. The calculation involves the determination of the sum of the squares of the distances of each unit from the center of gravity of the group and is tedious when the number of units is large.

When the group is symmetrical and the pitch along a line is constant, the following formula will be found convenient as applied to a line of aggregates:

$$\Sigma d^2 = \frac{p^2}{12}(n^3 - n),$$

where d is the distance of a unit from the center of gravity of the line, p the pitch and n the number of rivets.

For example, consider a line of 8 rivets spaced at 3 in., for which $n = 8$ and $p = 3$. Then

$$\Sigma d^2 = \frac{(3)^2}{12}[(8)^3 - 8] = 378.$$

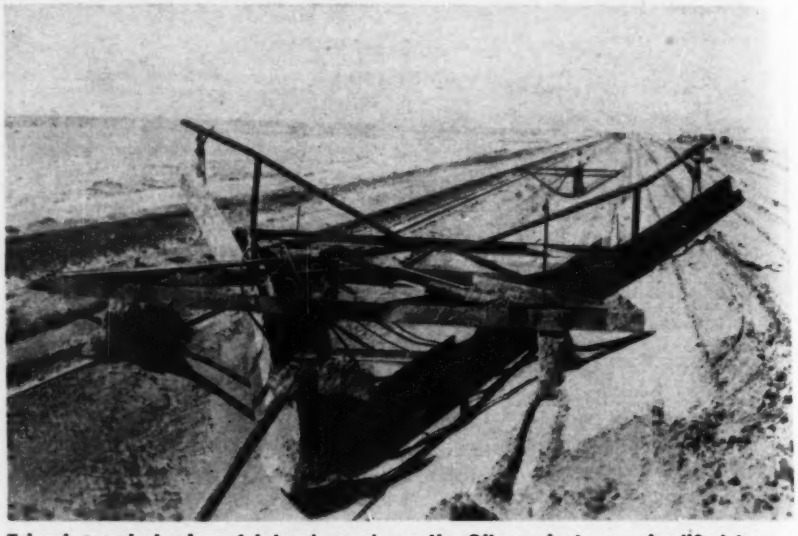
Frederick T. Vogt, *Designer, Bureau of Bridge and Buildings, City of Milwaukee, Wisc.*

Special Machine Speeds Shaping of Canal Banks

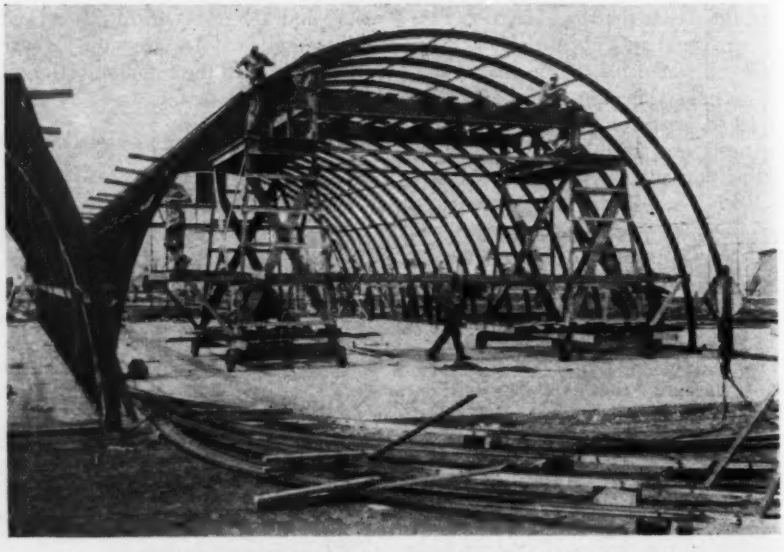
To simplify the trimming and shaping of the Yuma Mesa laterals of the Gila reclamation project, M. H. Hasler, contractor, used the special machine illustrated. The resulting reduction of manpower needs and increased speed of the work produced a considerable cost saving.

The machine was pulled along a steel rail on each bank of the lateral by a tractor operating in the bottom of the ditch. Installation of the steel rails was a quick operation and they were reused as work progressed. The position of the blade was adjusted by chains at the point and ends of the blade. After the trimming was completed the slopes and bottom of the canal were lined with pneumatically placed concrete.

The Gila project is being constructed by the Bureau of Reclamation. The work illustrated was done under the general direction of John K. Rohrer, acting construction engineer for the bureau, and Phillip M. Noble, bureau engineer in immediate charge. The machine was designed and built on the job by Hugh Coker, superintendent for M. H. Hasler, the contractor.



Trimming and shaping of lateral canals on the Gila project was simplified by use of the job-built machine shown above.



TRAVELING JUMBO SPEEDS WAREHOUSE CONSTRUCTION

Erection of 240 warehouses on a Pacific island, one unit of which is shown above, was speeded by use of a jumbo built out of 4x4-in. timbers and mounted on rubber-tired wheels salvaged from a welding machine. Each warehouse provides 4,000 sq.ft. of floor space, which is covered by a prefabricated building consisting of 25 semicircular ribs, seven transverse braces and 280 ft. of corrugated metal roofing. A crane set the ribs and the bracing and connection were placed from the jumbo.—R. P. Day, chief carpenter's mate, Construction Battalion, USNR.

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

Sidesway by Cross Method

Sir: In *ENR* Nov. 29, vol. p. 713, M. W. Rosenstein suggests that J. J. Polivka's results are not correct. I should like to submit the accompanying diagrams which contain the simple moment distribution results that agree with Mr. Polivka's exactly.

It will, in general, be found that the simple Hardy Cross method of distributing moments is more satisfactory and gives a better mental picture of the physical action of a building frame. Assume an horizontal displacement Δ_H to the right (Fig. *a*) so that fixed-end moments are + 26 for AB and +52 for CD. Distribute moments in this order: Joint C, then B, then C again. It is quicker than the fixed-point or conjugate-point method and is easier for the average practical engineer to apply.

The equilibrium moments and forces in Fig. *b* will demonstrate the correctness of J. J. Polivka's results.

C. W. DEANS
Vancouver, B. C., Canada

Sir: As far as the distribution is concerned, the results given by J. J. Polivka are correct, but when sidesway takes place in a structure the distributed moments are not true or final. So, although the moments shown in Fig. *b*, by C. W. Deans, were correctly distributed and are consistent with the force of 6.45 kips they do not correspond to the force of 7.8 kips required to produce the fixed-end moments listed in Fig. *a*.

The writer agrees with Mr. Deans that no time is saved by the direct distribution in this particular case; nevertheless, he feels that Mr. Polivka's demonstration was worthwhile.

M. W. ROSENSTEIN
Structural Engineer
Chicago, Ill.

New Tacoma Narrows Bridge

Sir: In the Nov. 29, 1945, issue of *Engineering News-Record*, vol. p. 716, there was published an article on the Redesign of the Tacoma Narrows Bridge, by Charles E. Andrew, chief consulting engineer, Washington Toll Bridge Authority.

The original design of the Tacoma Bridge had stiffening girders and plate girder floorbeams with the concrete roadway slab continuous over the full width of the bridge. The new design has deep stiffening trusses and open truss type floorbeams with the roadway slab having slots between the traffic lanes. These new features were introduced to minimize the aerodynamic forces which were the primary cause of failure of the old bridge.

Fig. 2, vol. p. 718 of *ENR* shows a cross section of the new design with the new features as mentioned above. While the principle is correct for reducing the aerodynamics forces, there are a number of objectionable features from a maintenance standpoint that are open to criticism, especially in the design of a long life structure of this kind. It was only a short time ago that for important bridge structures $\frac{5}{16}$-in. minimum thickness of material was considered satisfactory. Later this was increased to $\frac{3}{8}$ in. and at present some of the major railroads require material of not less than $\frac{1}{2}$ in. thickness, including bracing systems and lateral plates. This increase in section, regardless of stress in the members, was brought about due to rapid reduction in area caused by corrosion.

The following are a number of points that I would like to call to your attention:

1. The top chord of the open truss floorbeams is composed of two 10 in. channels, 15 lb., with a $\frac{1}{4}$-in. web.

2. A number of diagonals, posts and braces are 10 in. wide flange 15.5 lb. light weight beams, having a web and flange thickness of $\frac{1}{4}$ in.

3. The bottom chord member is a 6 in. H 25 lb. beam having a web thickness of $\frac{5}{16}$ in. The web of this beam is placed horizontally and forms a perfect trough for water and refuse.

4. The intersection of the diagonals with the bottom chord also forms a pocket for dirt and snow, which certainly will pass through the open grate floor.

5. The top flange of the stringers should be embedded into the roadway slab to brace the beams laterally.

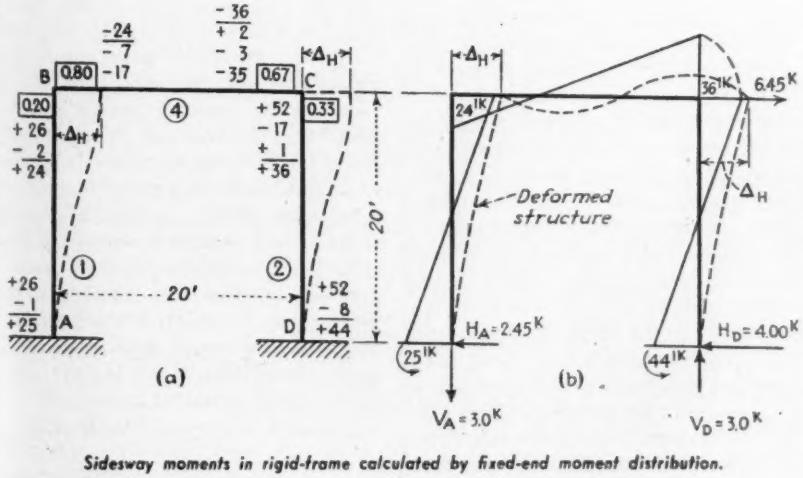
6. The floor slab will have an uplift at one end under certain loading conditions.

7. The concrete in the floor slab, for the span shown, will be stressed to 1,800 lb. psi. at the cantilever end and to 1,200 lb. psi. at the center of the span, under H20 loading.

8. The connections at Section A-A and at the bottom of the braces appear to be impractical.

9. The top of floor contemplated will give unsafe and unpleasant riding conditions because part of a vehicle may be riding on the concrete slab and at the same time the other part may be on the open grating floor. This certainly will be true in inclement weather.

I believe that with the thin structural shapes, pockets at the panel points and



Sidesway moments in rigid-frame calculated by fixed-end moment distribution.

thin roadway slab without protection course that it will not be many years before extensive repairs to this important long span structure will be necessary.

E. F. GIFFORD
Bellerose, L. I.

Sir: The letter from Mr. Gifford prompts the suggestion that it is unfortunate that an article such as the one under discussion cannot show a full set of plans in detail. However, most of your readers will realize that drawings such as the cross-sectional sketch of the proposed bridge is on too small a scale to show the wide fillets on the under side of the slab which do encase the top flange of the stringers. The reader who does not make allowances for such scale-reduction effects might say that we should put rivets in the truss connections, etc.

Perhaps we should have used a detailed sketch to show just how continuity is retained in the slab by bonding the crossbars of the roadway slots to the slab reinforcement, making the steel continuous through slabs and slots for the full width of the bridge. The text does state that *full continuity is preserved as a whole.*

We admit that there is no mathematical approach to the computation of stresses in the slab as designed. We were forced by other considerations of great importance to design a slab for which there is no precedent. In so doing we are not depending solely on the usual method of figuring slab stresses, but are making a full scale test with full wheel loads in which we will actually record stress and deflection at all critical points under the most severe loads.

We believe that these tests, which are now under way, will prove the design adequate. If not, we will use an alternate design incorporating jack stringers between main stringers to support the grids. Such an eventuality would require additional thickness in the slab and greater depth of boundary channels on the grids as the slab would then not pass continuous action. Density ratio of the grids would be increased and the flow of air through them decreased by the presence of jack stringers. This would decrease the aerodynamic efficiency and increase the necessary width of the grids. Also the bridge cost would be increased more than $100,000 by added slab and steel weight.

As to metal thickness, I refer Mr. Gifford to AASHO specifications for rolled shapes. If corrosion is allowed to start and to continue it makes little difference whether the metal is ¼ or ½ in. thick.

The bottom chord of the floor beam is provided with ¾-in. drain holes spaced 2 ft. apart. Driving clearances at section AA are ample. Mr. Gifford is evidently unfamiliar with weather conditions at the site. There is practically no snow and very little freezing temperature.

As to driving conditions we believe them to be ideal. Motorists will not drive on the floor gratings except in passing. They will be excellent dividing strips and will have a decided tendency to keep drivers in their proper lanes, a very important consideration on wide highway bridges.

Of the highway bridges in Washington, Oregon and California, 99 percent are provided with concrete floors having no so-called "protection courses." I have yet to see one failure of our type of concrete bridge floor surface and I have built many hundreds of them in the past 30 years. The San Francisco-Oakland Bay Bridge with the heaviest traffic in the world is an example.

As to concrete stress, I call Mr. Gifford's attention to the fact that with continuous action no cantilever action will exist over the stringers. At any rate, the full scale tests will give the answers.

CHARLES E. ANDREW
Chief Consulting Engineer
Washington Toll Bridge Authority
Olympia, Wash.

Tests on Clay Soils

Sir: The paper, "Tests of Compacted Clay Soils Provide Highway Design Guides" by Henry C. Porter (*ENR* Nov. 29, 1945, vol. p. 726) may well be discussed from another point of view.

Perhaps none would deny that the strength or ability of earth masses to resist forces tending to destroy them is of major importance. In the table Mr. Porter aptly terms it relative rupture load. If one compares the density of the cylinders with relative rupture load, he will observe that cylinders of the highest density are the ones that rupture only under loads of the greatest magnitude (cylinders *C, E, F, G, H, I*) and that the density of cylinders *B* and *D* is only 0.2 lb. per cu. ft. below that of the maximum of their respective groups. It will, therefore, be seen that the density-strength relationship is almost perfect.

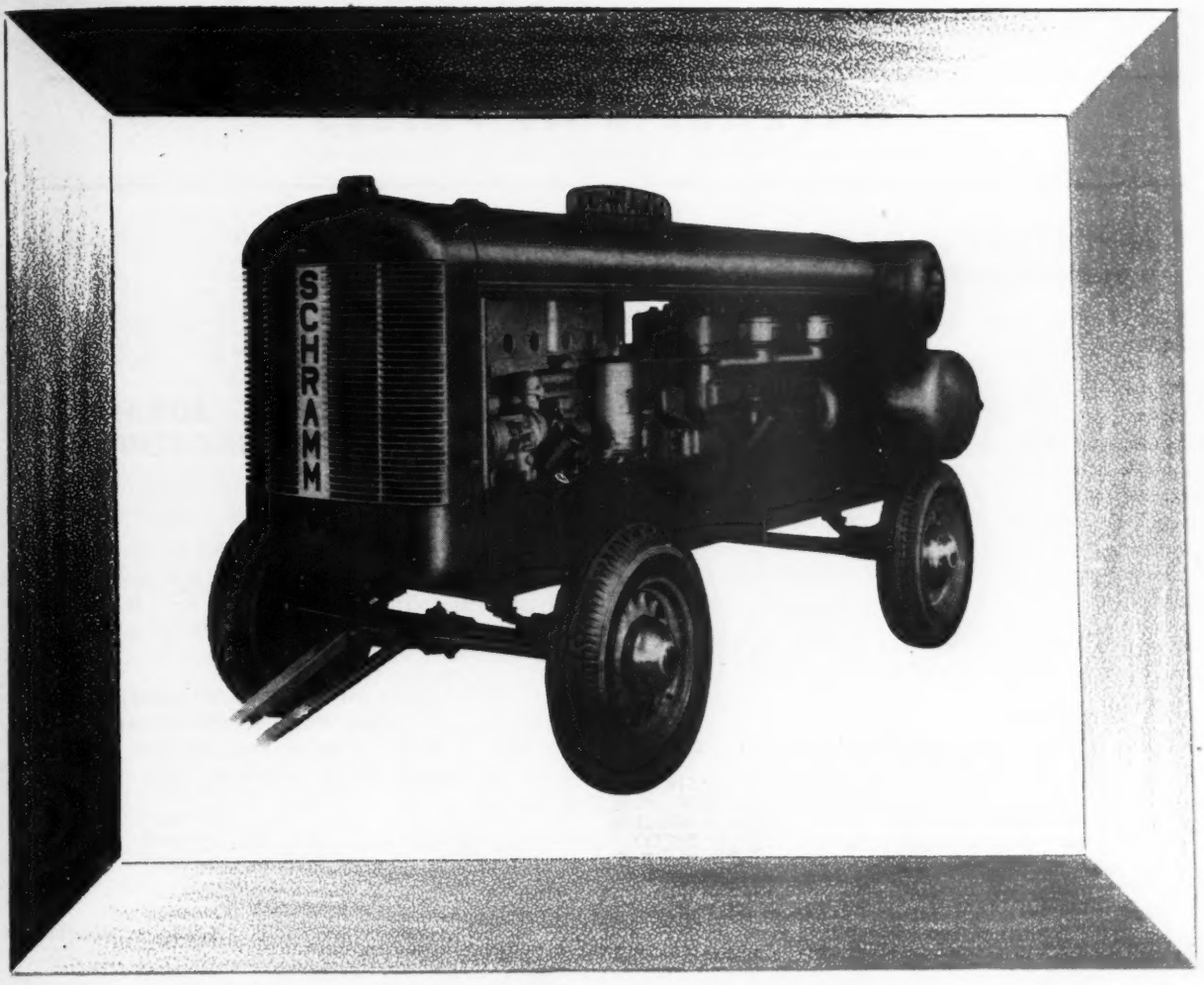
In a similar manner cylinders of the least density rupture under the smallest loads in every case, except those of the *A* group where densities and strengths are too nearly equal to yield fruitful comparison. Values given in the table also show that a similar relationship applies to other density and strength values. As the density-strength relationship is generally true of all materials having other properties identical, this is to be expected of clay bodies also.

The reader will observe that the deformation of the cylinders decreases with the lowering of the moisture content. Under the highest moistures, no doubt much of the deformation is of the plastic type. This is another trend to be expected.

Concerning the relationship between the number of rammer blows and the magnitude of rupture, shown by Fig. 2, one observes a fairly constant increase of each until a point is reached where the weight of the rammer becomes ineffective for continuing the relationship. Whether one should increase the weight of the rammer or the number of its blows to continue this relationship can be determined only by trial; and indeed, if one should determine the magnitude of compactive effort required to produce the essential density of a given type of earth, this does not necessarily mean that it would give comparable results even on another similar material.

A certain type of earth may or may not respond in the least to compactive effort. For example, standard Ottawa sand or steel ball bearings respond only negligibly to compactive effort, though well-graded mixtures of sand and clay respond readily. In like manner, one does not attempt to estimate the power output of a steam engine on the basis of heat units of coal consumed when the efficiency of the machine is unknown. Moreover, an attempt to estimate the efficiency of an untried body of clay, subjected to a given amount of compactive effort, to resist the forces of traffic and weather is likewise fallacious. The quality of a product is measured only in terms of its ability to serve the purpose for which it was intended and not by the energy spent in producing it; hence, density only but not compactive effort is related to strength.

IRA B. MULLIS
Consulting Engineer
Raleigh, N. C.



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CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

IMPROVEMENT OF HIGHWAYS HUNTERDON COUNTY, N. J.

OWNER: New Jersey State Highway Department. C. F. Bedwell, construction engineer.

PROJECT: Reinforced concrete paving of half of divided highway for 2.768 miles, from VanSykles Corner to White House, Hunterdon County, New Jersey. Including 43,673 cu. yds. of earth roadway excavation; 49,129 sq. yds. 10 in. reinforced concrete paving surface and 65,985 lbs. reinforcing steel in structures. All materials to be furnished by contractor and work to be completed in 125 calendar days. Rail and highway transportation facilities available.

BIDS: Six bids were received on October 10. 1945, ranging from the contract low of $528,743 to $605,540.

LIST OF BIDDERS

• Franklin Contracting Co., Newark, N. J. (contract)	$528,743
Woodcrest Constr. Co., N. Y. C.	547,768
Weldon Constr. Co., Westfield, N. J.	578,489
R. W. Cleveland Co., E. Orange, N. J.	581,798
F. A. Canuso, Philadelphia, Pa.	601,831
S. J. Groves & Sons, Woodbridge, N. J.	605,540

Item	Quantity	Unit Prices (1)	(2)
1. Roadway Excavation-Earth	43,673 cu. yds.	$0.50	$1.30
2. Pavement Excavation	6,197 sq. yds.	0.50	1.50
3. Ditch Excavation	250 cu. yds.	2.00	2.00
4. Channel Excavation	500 cu. yds.	2.50	2.00
5. Subbase	19,500 cu. yds.	1.40	2.00
6. Subgrade	49,422 sq. yds.	0.20	0.20
7. 2" Resurface Stone Shoulder	15,518 sq. yds.	0.20	0.60
8. 7" Stone Shoulder	4,356 sq. yds.	0.80	0.82
9. 8" Stone Shoulder	27,700 sq. yds.	0.90	1.00
10. Porous Fill	500 cu. yds.	2.00	2.45
11. 4" Topsoiling	48,500 sq. yds.	0.45	0.30
12. 6" Topsoiling	550 sq. yds.	0.60	0.35
13. Sodding	1,100 sq. yds.	1.25	0.85
14. Conc. Bag Slope Protection	700 cu. yds.	20.00	15.00
15. 4" Macadam Base Course	6,600 sq. yds.	0.90	0.15
16. 2" Mod. Pen. Mac. Inter. Course	6,600 sq. yds.	0.70	0.80
17. 1" Pavement, Type A or T	11,250 sq. yds.	0.65	1.00
18. 2" Pavement, Type A or T	4,500 sq. yds.	1.20	1.50
19. 10" Rein. Conc. Pavement Surf.	49,129 sq. yds.	4.80	4.50
20. 18" Bridge Approach Slabs	133 sq. yds.	9.00	7.46
21. Underdrain, Type F	2,300 lin. ft.	1.90	0.90
22. 18" Rein. Conc. Culvert Pipe	1,867 lin. ft.	3.75	3.50
23. 24" Rein. Conc. Culvert Pipe	150 lin. ft.	6.50	5.00
24. 6" Bit. Coat. Corrug. Metal Pipe	120 lin. ft.	2.50	1.60
25. 12" Corrug. Metal Pipe	82 lin. ft.	4.00	2.75
26. 18" Corrug. Metal Pipe	50 lin. ft.	5.75	8.00
27. Manholes	2	150.00	200.00
28. Inlets, Type B and D	24	150.00	200.00
29. Inlets & Manholes, Exist. Castings	3	125.00	150.00
30. Reset Inlet Heads	36	25.00	20.00
31. Reset Manhole Heads	1	25.00	20.00
32. 10" Concrete Gutter	450 sq. yds.	5.65	3.30
33. Grouted Rubble Stone Gutter	130 sq. yds.	3.90	3.50
34. White Conc. Vert. Curb	3,000 lin. ft.	1.65	1.32
35. White Conc. Sloping Curb	5,500 lin. ft.	1.70	1.41
36. Headwalls	40 cu. yds.	45.00	40.00
37. Culvert	8 cu. yds.	50.00	40.00
38. Class "C" Conc. in Steps	10 cu. yds.	45.00	50.00
39. Class "B" Conc. in Pav. Footings	15 cu. yds.	20.00	15.00
40. Monuments	25	25.00	15.00
41. Wire Rope Fence	3,900 lin. ft.	1.65	1.30
42. Guard Fence Anchorages	19	90.00	70.00
43. Reset Wire Rope Fence	1,350 lin. ft.	0.90	0.70
44. Single Guard Rail Posts	20	4.60	4.00
45. Cleaning Exist. Drainage Struc.	Lump Sum	1000.00	750.00
46. Relaid 36" Plain Conc. Pipe	30 lin. ft.	4.00	10.00
47. Field Office	Lump Sum	1500.00	2000.00
48. Broken Stone or Gravel	250 cu. yds.	4.00	3.60
49. Relaid 24" V. C. Pipe	20 lin. ft.	4.00	10.00
50. 14" Rein. Conc. Pavement Sur.	160 sq. yds.	7.00	4.85
51. Pulverising & Processing Soil	3,936 sq. yds.	1.00	1.75
52. Portland Cement for Soil	2,125 bags	0.75	0.75
53. Bit. Treatment for Soil	2,362 gals.	0.15	0.17
54. Cover Material for Soil	69 tons	3.00	2.00
55. Channel Excavation	1,930 cu. yds.	3.00	2.00
56. Foundation Excavation	1,033 cu. yds.	7.00	8.00
57. Class B Conc. in Structure	344 cu. yds.	45.00	50.00
58. Class C Conc. in Structures	1,042 cu. yds.	27.00	37.00
59. Class D Conc. in Structures	145 cu. yds.	26.50	25.00
60. Concrete Balustrade	138 lin. ft.	8.00	7.00
61. Rein. Steel in Structures	65,985 lbs.	0.10	0.09
62. Structural Steel	55,550 lbs.	0.55	0.07
63. Waterproofing	100 sq. ft.	1.00	1.00
64. Clearing Site, Br. Sta. 374/21.0	Lump Sum	350.00	800.00
65. Clearing Site, Br. Sta. 392/40.0	Lump Sum	350.00	800.00
66. Clearing Site, Br. Sta. 408/15.0	Lump Sum	350.00	800.00
67. Field Office	Lump Sum	850.00	1279.92

HIGHWAY GRADING, ADVANCE CLEARING, WASHINGTON

OWNER: Public Roads Administration, Bedell Building, Portland Oregon. W. H. Lynch, division engineer.

PROJECT: Grading and advance clearing for the Republic-Kettle Falls highway, Colville National Forest, Ferry County, Washington; including 121,500 cu. yds. of unclassified excavation and the finishing of 2.125 mi. earth-graded roads.

CONDITIONS: Contractor to furnish all materials and complete work in 175 days. Rail and highway transportation facilities available. Wage rates specified are: skilled; $1.85 per hr.; semi-skilled, $1.40 per hr.; and common, $1.00 per hr.

BIDS: Six bids were received on Nov. 1, 1945, ranging from the contract low of $108,360, to $132,247.

LIST OF BIDDERS:

1. E. W. Elliott, Seattle (contract)	$108,360
2. C. E. Oneal, Ellersburg, Wash.	109,986
3. Colonial Constr. Co., Spokane	119,355
4. M. J. Kuney Co., Spokane	127,431
5. Goetz & Brennan, Seattle	129,505
6. Goodfellow Bros., Inc., Wenatchee, Wash.	132,247

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Extra and misc. force account work	All	$500.00	$500.00	$500.00
2. Clearing	29 acres	300.00	500.00	300.00
3. Grubbing	15 acres	300.00	200.00	150.00
4. Selected removal trees and snags	200 s. f.	2.00	4.00	4.00
5. Unclassified excavation	121,500 c. y.	0.70	0.68	0.80
6. Unclassified excavation, structures	350 c. y.	2.00	3.00	3.00
7. Unclassified excavation, borrow, case 1	1,000 c. y.	0.70	0.40	0.80
8. Overhaul (1000-ft. free haul)	33,000 sta. y.	0.03	0.02	0.02
9. Spec. overhaul, borrow (1000-ft. free haul)	300 c. y. m.	0.20	0.18	0.20
10. Roadside cleanup	4 acres	300.00	400.00	300.00
11. Finish earth graded roads	2.125 mi.	800.00	500.00	600.00
12. Cement rubble masonry	8 c. y.	20.00	20.00	25.00
13. Bituminous coated corrugated sht. met. culv. pipe, Type 1, 18-in.	1,100 l. f.	3.00	3.00	4.00
14. Bit. ctd. prf. corr. glv. sht. met. pipe, underdrain, 8-inch	50 l. f.	2.00	2.00	2.20
15. Paved culvert inlets, Type 1	30 s. y.	10.00	6.00	5.00

RIPRAP PLACEMENT, COL.

OWNER: Bureau of Reclamation-Big Thompson project, Colorado. C. H. Howell, project engineer.

BIDS: Two bids were received on November 19, 1945, ranging from the low of $23,300 to $32,500.

LIST OF BIDDERS:

1. Henry Shore, Littleton, Colo.	$23,300
2. Trione Contracting Co., Denver, Colo.	32,500

Item	Quan.	Unit Prices (1)	(2)
1. Producing and transporting riprap	4,700 c. y.	$4.00	$5.00
2. Placing riprap on upstream slopes of embankments	4,300 c. y.	1.00	2.00
3. Stockpiling riprap material	400 c. y.	.50	1.00

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MANUFACTURERS' LATEST DEVELOPMENTS IN EQUIPMENT AND MATERIALS

Tractor-Mounted Unit

Tasks for bulldozer, dragline, clamshell and crane may be performed by a single new unit, the Hystaway, according to the manufacturer's statement. This tractor-mounted unit, which can be installed in two hours, retains full tractor mobility, as crawler track oscillation is not impeded.

High partial use of the bulldozer can be made without removing the Hystaway from the rear of the tractor; for full bulldozer production and other conventional uses, the unit may be removed from the tractor in an hour.—*Hyster Co., Portland, Ore., and Peoria, Ill.*

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Portable Nozzle Tester

For use with all popular makes of diesel engines, a new portable Universal diesel nozzle and injector tester requires no technical knowledge for operations including measurement of injector opening pressures, detection of irregularities, etc.

The tester, weighing about 19½ lb., is equipped with a standard hydraulic pressure gage, 3 11/16-in. dial and an all-steel carrying case. It is available in 3,000, 5,000 or 7,500 psi. capacity, with 100 lb. gradations.—*The Buda Company, Harvey, Ill.*

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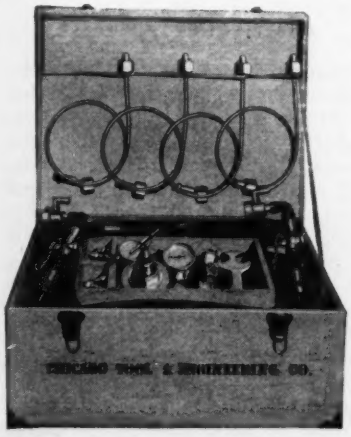
Underwater Cutting Torch

Four years of development and experimental work are behind the new Palmgren underwater torch. It is said to be



so simply constructed and easy to operate that after a very few minutes of instruction various thicknesses of steel can be cut under water.

A special tubular steel electrode, used with the Palmgren torch, using oxygen, assures safe operation at any depth.—*Chicago Tool & Engineering Co., 8383 South Chicago Ave., Chicago 17, Ill.*

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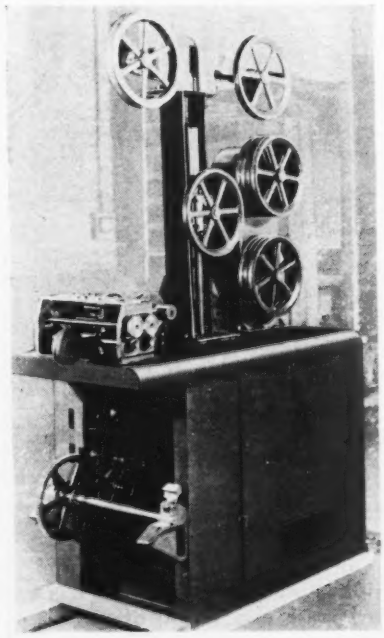
Wind-Up Machine

A complete, self-contained wind-up machine is available, for wire, cable, cords, tape, etc. It has combination variable speed and hydraulic synchronizing equipment, for constant speed



and tension within a varied production range. Wire tension may be changed from a few ounces to hundreds of pounds, it is claimed, by arrangement of adjustable counterweights.

In two sizes, this motor-driven machine requires no outside source of power or synchronization. Machines for extrusion wind-up and for continuous wind-up are also available, as are unwind stands, in standard sizes, for semi-automatic operation.—*Industrial Oven Engineering Co., 11621 Detroit Ave., Cleveland, Ohio.*

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Strainer

Designed with a snug-fitting removable sleeve, a new "Y" strainer may be installed in almost any position on a pipeline. The strainer basket may, if desired, be magnetized for intercepting metal particles. The hydrostatically tested unit is available with or without a cleaning plug, or with a threaded blow-off connection.

This strainer, in cast bronze, steel, semi-steel or cast iron is made in a wide range of sizes for flanged, welded or threaded connections.—*J. A. Zurn Mfg. Co., Erie, Pa.*

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Direct-Fired Heater

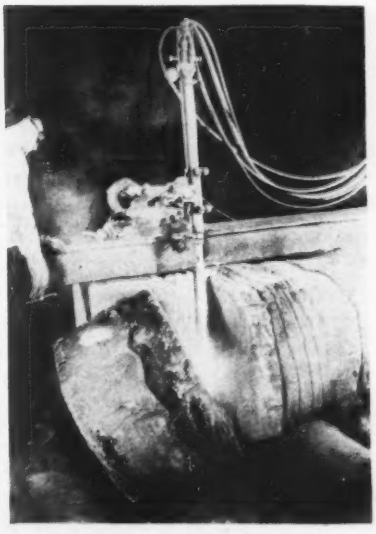
Available for all types of fuel, a new line of direct-fired heaters range from 75,000 to 2,000,000 Btu. output per hour. These all-steel, self-contained units are equipped with fully automatic control systems.

Some of the innovations are: Unit shipped in two sections, for unloading and placing without heavy crane facilities; filters applied without special transformations requiring extra floor space; thermostatically controlled humidification.—*Herbert H. Davis Co., Circero, Ill.*

• • •

Heavy-Duty Blowpipe

Water-cooled, for mounting on a straight-line cutting machine, the new Oxweld C-45 oxy-acetylene blowpipe cuts steel from 16 to 50 in. thick. A 50-lb. gage attached to the blowpipe body checks cutting-oxygen pressures, which



are never over 35 lb. psi., it is stated.

The blowpipe, designed for operating with medium-pressure acetylene, will operate satisfactorily on a generator or a manifold having a minimum hourly capacity of 500 cu. ft. of acetylene. A

● The seal that keeps the water in and the air out consists of two wearing surface seal rings made of Tungsten Carbide and a grease container. One seal ring rotates on the shaft and is held in contact with the stationary ring by a stainless steel spring. This method of sealing is specially suited for high pressure work and when handling dirty water—the higher the pressure the tighter the seal. Dirty water cannot get into the grease and damage the shaft and bearings. Air is kept out of the pump so there's no loss of vacuum and high priming efficiency is maintained.

For details, see your local Carver distributor or write direct.

THE CARVER PUMP CO., Muscatine, Iowa

special holder is also available, with which a total angular adjustment of 135 deg. can be obtained in the plane of the cut.—*Linde Air Products Co., 30 East 42nd St., New York, N. Y.*

• • •

Large Generator

Several large size generators have been added to a line of revolving field type units, bringing it to a range of 5 through 100 kv. sizes. One of the latest models, rated at 50 kw. at 80 percent pf., 62.5 kva. at 1,200 rpm., will furnish 127/220 volts A-C, 60 cycle, 4-wire, but is also available for standard voltages and frequencies.—*The Kato Engineering Co., Mankato, Minn.*

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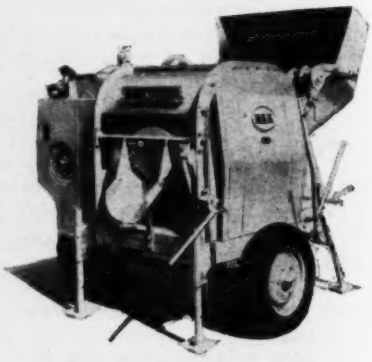

Streamlined Concrete Mixer

A new Rex 6S concrete mixer has a completely redesigned chassis, with low overall height, wide wheel tread and low center of gravity. New convenient controls are grouped on one side of the machine, and a new water system and drum design are said to result in easier operation and better mixing qualities. —*Chain Belt Company, 1600 West Bruce St., Milwaukee, Wis.*

• • •

Autoxidation Process

Arrangement for the use of the Autoxidation Process—a method for producing ferrous sulphate, ferric sulphate or sulphuric acid—in water treatment, chemical treatment of domestic sewage, odor control at sewage treatment plants, sludge conditioning for filtration, and in the industrial waste treatment field, may now be made through *Harmon E. Keyes*, chemical and metallurgical engineer, *508 East Culver St., Phoenix, Ariz.* Mr. Keyes can furnish estimates on capacity, general layout and operation details.

This process is said to have been successful in small-scale operation for over six years at the Phoenix, Ariz., sewage treatment plant. As the raw materials used are scrap iron from a city dump and elemental sulphur, the process is inexpensive.

Firestone Announces

A SENSATIONAL NEW OFF-THE-HIGHWAY TIRE

the Wire Cord

AGAIN Firestone pioneering leads the way with another epochal development — THE FIRESTONE WIRECORD Off-the-Highway Tire.

In this, the strongest tire ever built, the body cords are twisted strands of wire. Every cord in every ply is five times as strong as the strongest cord heretofore used.

This cooler-running tire takes unbelievable punishment without blowing out, puncturing, or failing from any of the causes that ruin ordinary tires prematurely.

FIRESTONE WIRECORD Off-the-Highway Tires are now proving their superior performance in logging, strip-mining and other operations where the vehicle is forced to travel over rough roads under heavy loads.

Although not yet in volume production, this amazing new type tire is another example of Firestone's leadership in bringing you the Best Today . . . Still Better Tomorrow.

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Firestone
Wire Cord
OFF-THE-HIGHWAY TIRE

Fine Engineering Instruments

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L&S

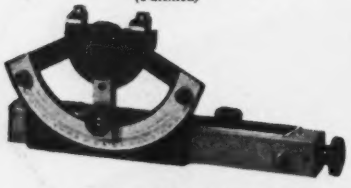
We always figured in our shop that if we built engineering instruments *good enough*, they would be used around the world. Here are two Leupold products that are popular—maybe you need one or both of them:

LEUPOLD HAND LEVEL

Light. Durable. Compact. Designed so that you can adjust permanently the magnification of the bubble to each individual eye. Finished in crystal grey with black trim. 5¼ in. long—¾ in. diameter. Comes in a leather case.

LEUPOLD ABNEY LEVEL

(Patented)



Designed to change readily from one graduation to another without reversing the frame; also to adjust permanently the magnification of the bubble to each individual eye . . . 6½ in. long — radius of arc 1¾ in. Furnished with leather case.

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Elections and Activities

Newly elected officers of the Ohio Home Builders Association are: Joseph B. Haverstick, Dayton, president; A. J. Alexander, Akron, vice president; Alex A. Treuhaft, Shaker Heights, treasurer, and Earl Bailey, Youngstown, secretary.

James J. Wass, Warren, Ohio, has been elected president of the Mahoning Valley Society of Professional Engineers for 1946. Others elected are: Henry J. Waldeck, Warren, deputy county engineer, Trumbull County, vice president; Albert Coope, Youngstown, Mahoning County sanitary engineer, secretary; Clyde E. R. Wenrich, Treasurer; Harry A. Loria, H. T. Williams, and Bruce W. Weaver, directors.

I. F. Stern, consulting engineer, Chicago, Ill., has been elected president of the Illinois Section of the American Society of Civil Engineers, succeeding Ralph H. Burke. Other newly elected officers for 1946 are vice-presidents L. R. Howson and George S. Salter. A. L. R. Sanders was elected secretary.

Life memberships in the society were awarded to Edward J. Kelly, mayor of Chicago, and the following residents of that area: C. R. Andrew, J. R. Cahill, F. L. Copeland, E. H. Dunmire, E. O. Griffenhagen, R. F. Kelker, Jr., G. B. Massey, H. P. Ramey, F. A. Randall, F. M. Randlett, and C. R. Rowe.

Arthur C. Sather has been elected president of the Spokane, Wash., chapter of the Associated General Contractors, with Walter Meyers and James Quick as vice-presidents, S. G. Morin and Frank Heath as directors, and Verne Warren as secretary-treasurer.

John C. Long, president of the Long Construction Co., has been elected president of the Kansas City section of the American Society of Civil Engineers, succeeding M. P. Hatcher. Lieut. Col. Samuel J. Callahan, now in Germany, but scheduled to return soon, was elected vice-president; Ansel N. Mitchell, second vice-president, and Josef Sorkin, secretary-treasurer.

Life membership in the national organization was awarded to: Herman H. Fox, Alex R. Young, and William H. Bosier. All have been members of the society for thirty-five years.

Philip Tuttle Williams, has been selected as executive secretary of the Carolinas branch, Associated General Contractors of America, Inc. He succeeds Frank H. Conner, who resigned recently to join the A. H. Guion Co.

Frank H. Wyatt, who served in the construction division of the Army Engineers in both world wars, has been elected president of the recently established San Diego, Calif., post, Society of American Military Engineers.

W. L. McFadden was elected first vice president; R. F. Edwards, second vice president; Wirt W. Jones, secretary; George E. Dyson, treasurer, and John E. Birdsall, assistant treasurer.

The Building Trades Employers Association of Milwaukee, Wis., has elected the following officers for 1946: Arthur J. Orust of Selzer Orust Co.; W. H. Emory of Klug & Smith Co.; N. J. Klein of Patek Bros., Inc.; Henry Jaeger of Jaeger Sand & Gravel Co.; Ervin Endlich of Endlich Construction Co.

Lieut. Col. George R. Schneider of the Little Rock district of United States Army Engineers has been elected president of the Mid-South section of the American Society of Civil Engineers. George L. Koomos of Vicksburg, Miss., was named vice-president and Ben Dees, Little Rock, Ark., was selected as secretary-treasurer. Board members are I. G. Norton, Memphis, Tenn., and William Turnbull, Vicksburg.

Officers of the Carolinas Road Builders Association have been elected as follows: E. H. Hines, Greenwood, president, John Thompson, Greensboro, vice president, and Warren J. Mann, Raleigh, secretary-treasurer. The governors are: C. P. Ballenger, Jr., Greensville, S. C., T. P. McMeekin, Cheraw, Gregory Poole, Raleigh, K. Sloane, Fayetteville, San Dreyfus, Columbia, and Walter Smith, Charlotte.

The Texas Society of Professional Engineers, Fort Worth Chapter, has elected the following officers: Joe J. Rady, president; C. I. Hendricks, first vice-president; C. M. Thelin, second vice-president; W. A. Satterwhite, secretary; A. B. Carson, treasurer.

E. J. Maupin, Jr., of Fallon, Nevada, president of the Dodge Construction Co., Inc., recently was elected president of the Nevada Chapter of the Associated General Contractors. Vice-presidents are Earl Games and Ludwig Flyge of Reno, and C. V. Isbell was named treasurer. and C. V. Isbell was named treasurer of the chapter.

MEMO

TO ALL CONSTRUCTION SUPTS...

Better look into High Speed Loading and make every truck count— W.F.B.

Increased yardage . . . increased truck trips, with fewer service interruptions —and less cost! That's what a Model 75 Haiss means to you. It's the Loader that "bites" fast into stock piles or banks . . . the Loader that handles *anything* a man can shovel. Popularly priced, too.

Best of all, count on Haiss for mechanical reliability. Engineered end-to-end . . . top-to-bottom—and equipped with an oil-bath-enclosed transmission to make extra sure it can "take it." Investigate Haiss now—while making plans for a more profitable postwar future. Complete information will be sent promptly on request.

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Model 75W Haiss Loader— 3 yds. per minute capacity. Also with creeper tread mounting as Model 75C.

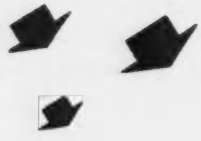
Model 77 with high elevator

Model 80 —5 yds. per min

Model 135 —8 yds. per min.

HAISS

. . . make it STRONG but keep it LIGHT



Gaining strength and light weight through sound functional design and the elimination of superfluous weight is one trend that has received great impetus during recent years.

Much of this has been accomplished through the use of lighter metals. But in Taylor Spiral Pipe this light weight has been obtained through the efficient use of steel by forming it into pipe with a strong, reinforcing spiral seam that eliminates superfluous weight.

Because of this combination of strength and light weight Taylor Spiral Pipe is ideally suited for many special purposes—like long water lines over rough country, dredge lines and jobs where pipe is to be moved and changed. Because it works so well in such services you possibly have overlooked its application in the wide range of everyday piping needs—jobs where portability is not a factor but where overall economy almost always is.

When you plan that next piping job keep in mind that the light weight of Taylor Spiral Pipe often cuts installed cost to half that of Standard Thickness pipe. Remember too, that its reinforcing spiral seam makes it stronger than any other type of pipe, size for size and gauge for gauge.

Change to TAYLOR SPIRAL PIPE FOR . . . . .

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- Sand and Gravel Lines
- Blower Piping
- Swing Pipe
- Spray Pond Piping
- Hydraulic Mining
- Dredge Lines

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General Offices & Works: Chicago, P.O. Box 485 *New York Office:* 50 Church St.

Philadelphia Office: Broad Street Station Bldg.

Men and Jobs

Howard O. Charnock, Jr., of Asheville, N. C., a graduate of North Carolina State College, has been promoted to captain at Paris, France, where he is serving with the Army Engineers. He has been overseas three years.

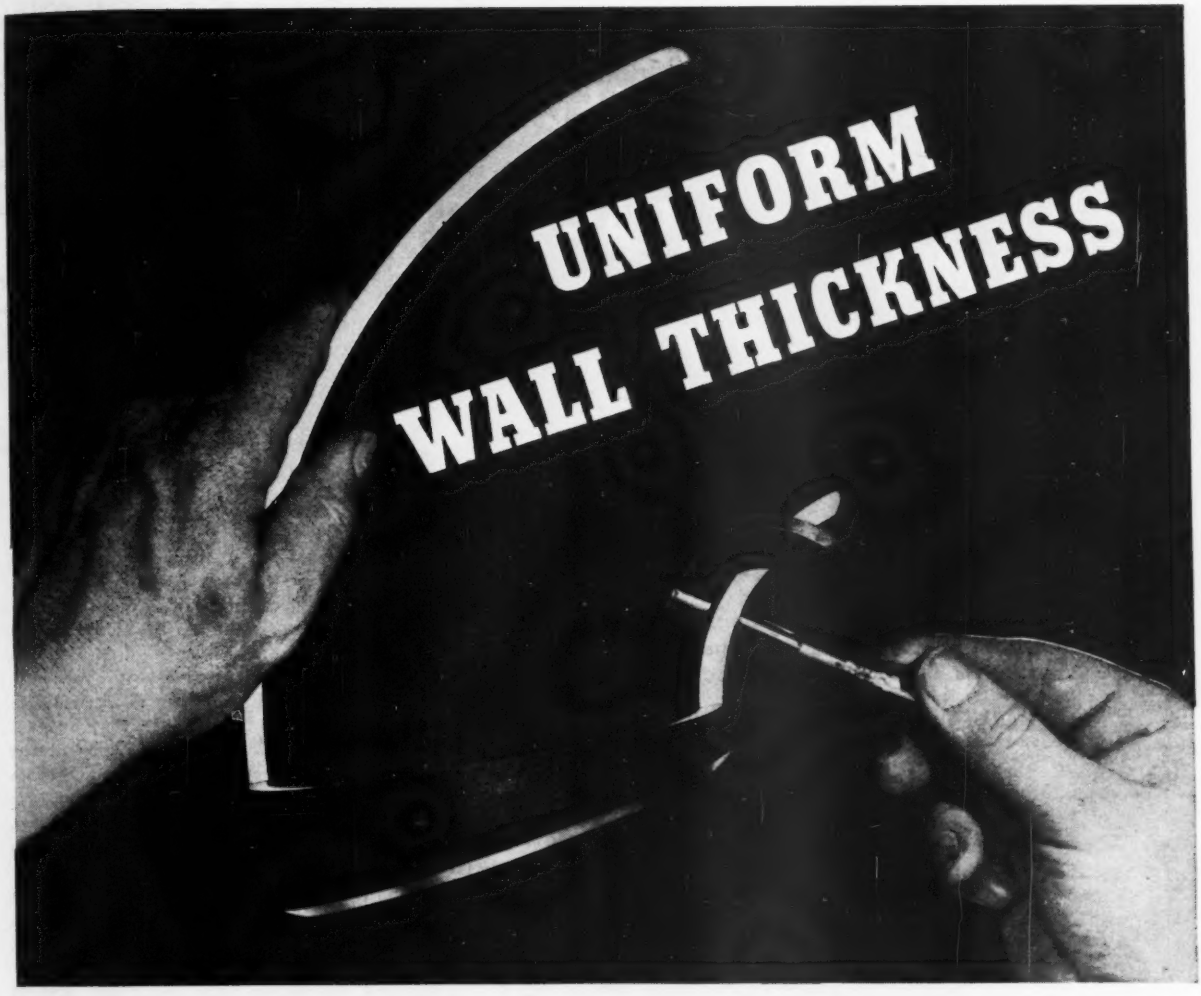
A. C. Fulmor has resigned after 31 years as Riverside, Calif., county surveyor, and has been succeeded by **A. C. Keith,** since 1923 his deputy.

W. S. McDonald, former administrative engineer of Dallas, Tex., has been made assistant director of public works for the city to replace **J. C. Bisset** who became assistant city manager Jan. 1. McDonald holds a civil engineering degree from Southern Methodist University. He joined the Dallas Public Works Department in 1942, going there from the Texas State Highway Department.

The Bureau of Community Facilities of the Federal Works Agency has announced the appointment of **William D. Jones** as division engineer, Division No. 1, embracing New England, New York and New Jersey, to succeed **L. A. Gillett,** who resigned Jan. 16 to become assistant chief engineer of the Virginian Railway Co. at Norfolk, Va. Mr. Jones is a graduate of Columbia University and formerly was construction engineer on highway and tunnel projects. **W. H. Sindt** has been promoted from acting division engineer to division engineer for Division No. Six, Texas, Arkansas, Louisiana and Oklahoma, with headquarters at Fort Worth, Tex.

The following changes have been made in the engineering organization of the Great Northern Railway: **C. M. Nye,** chief engineer since 1940, retires, and **H. J. Seyton** succeeds him. Mr. Nye has been with the Great Northern Railway or one of its subsidiary lines since 1909. Mr. Seyton, assistant chief engineer with headquarters at Seattle, has been in that capacity since 1938 and has been with the Great Northern Railway since 1909. **H. M. Goehring,** office engineer, St. Paul, becomes assistant chief engineer with headquarters at Seattle. **M. A. McChesney,** formerly chief draftsman, St. Paul, becomes office engineer, and **H. G. Dimond** now becomes chief draftsman.

New Seaboard Air Line Railway engineering appointments are **C. H. Burks,** assistant chief engineer at Norfolk, Va.; **W. R. Cox,** division engineer, Savannah, Ga.; and **G. A. Calhoun,** division engineer, Tampa, Fla.



an important feature of the Tube Turns line

WHEN a 180° fitting must be cut to an odd angle to meet special conditions, uniform wall thickness is of prime importance. Tube-Turn fittings have uniform wall thickness within ASA tolerances at all points throughout the fitting. Cut to any odd angle, they will line up perfectly with the pipe.

There are more than 4,000 items in the complete Tube Turns line—the *first* line of seamless welding fittings, in point of time, in strength, safety, economy and efficiency. Among refineries, processing plants, power plants and equipment manufacturers, Tube-Turn welding fittings are known for all around excellence and dependability.

The long and varied experience of Tube Turns engineers is available to you through selected Tube Turns distributors in every principal city, commanding the full resources of all Tube Turns branches and the home office. Write today for your free copy of Catalog 111.

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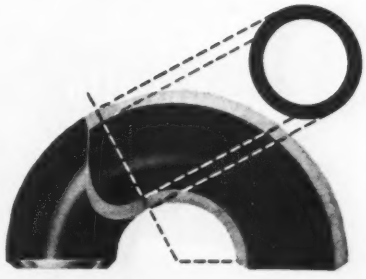
Selected Tube Turns distributors in every principal city are ready to serve you from their complete stocks.

TUBE TURNS (Inc.), Louisville 1, Kentucky. Branch Offices: New York, Washington, D. C., Philadelphia, Pittsburgh, Cleveland, Detroit, Chicago, Houston, San Francisco, Seattle, Los Angeles.



Quality control and inspection assure uniform wall thickness within ASA tolerances at all points. Full circularity is maintained throughout.

TUBE-TURN TRADE MARK **tt** *Welding Fittings and Flanges*

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Races against personnel uncertainties—

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Whether your job is large or small, you should investigate the advantages of Blaw-Knox Steel Forms, and you will want to use the time-saving money-making methods explained in the Blaw-Knox Steel Forms Bulletin No. 2035.

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No. 2035
On Your Letterhead

For the man who builds TUNNELS, SEWERS, WALLS and other concrete structures

BLAW-KNOX DIVISION
of Blaw-Knox Company
FARMERS BANK BUILDING
PITTSBURGH, PENNA.

BLAW-KNOX STEEL FORMS

Frederick D. Farnsworth, Rockland, Me., civil engineer with special training in municipal engineering, has been named city manager of Rockland. He has served in a similar capacity in Bangor, Brewer and Fort Fairfield. Since 1943 he has been associated with the Federal Housing Administration as construction engineer in war work with headquarters at Bath.

Dan W. Wood, engineer and **Henry A. Koch,** architect, after four and one-half years with U. S. Engineer Office, Denver district, have reopened their consulting office for the practice of structural engineering and architecture.

About District Engineers

Lt. Col. James S. Barko, West Point graduate of 1937, recently returned from Europe where for 18 months he commanded the 374 Engineers General Service Regiment, is taking the place of **Maj. J. H. Dodds,** for nine years in charge of maintenance and operations as executive officer to **Col. W. E. Lorence,** district engineer in Pittsburgh, Pa.

Col. E. E. Haring, Army district engineer at Wilmington, N. C., since June, 1943, has been transferred to Charleston, S. C., as district engineer. He has been succeeded at Wilmington by **Col. George W. Gillette.**

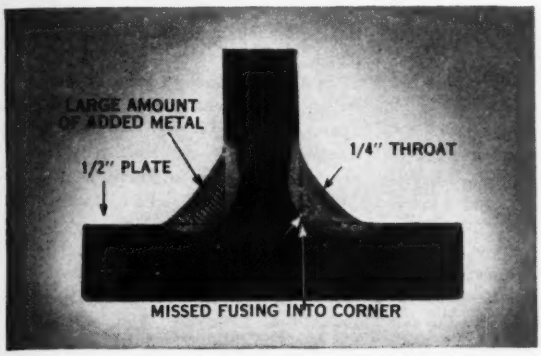
Lt. Col. Norman Haner, former consulting engineer of Seattle, Wash., has been assigned to the Seattle District U. S. Army Engineers, having been transferred from his former post as executive officer of the Boston, Mass., Engineer District. He joined the Army Engineers in 1934 and has served with them as civilian engineer on the design of Bonneville Dam for the Portland, Ore., District, on fortification design in the San Francisco Engineer District, and on flood control and fortification work in Providence, R. I.

Maj. Ernest L. Proud, West Roxbury, Mass., formerly associated with the Metropolitan District Water Supply Commission, Massachusetts, 1929-1941, has been appointed executive officer of the New England Division of the U. S. Engineers, Boston.

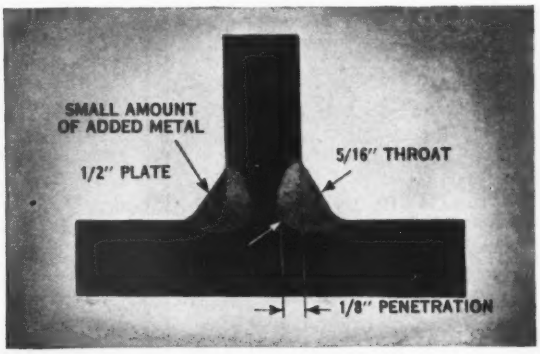
Col. Herbert D. Vogel has succeeded **Lieut. Col. N. J. Riebe,** engineer for the Buffalo district. Colonel Vogel recently returned from Tokyo. He drew plans for the Army Engineers' laboratory at Vicksburg, Miss., and was its director until 1934. In 1934 he was assigned to other Army work, spent two years in Hawaii, and returned as district engineer at Pittsburgh, Pa., later being assigned to the Pacific. Colonel Riebe, a reserve officer, is joining the Cleveland Pneumatic Tool Co.

LOOK, A. E., how the "Fleet-Welding" technique makes nonsense of old-time conceptions in the welding of horizontal fillets:

OLDTIME: 5" PER MINUTE



NEWTIME: 12" PER MINUTE

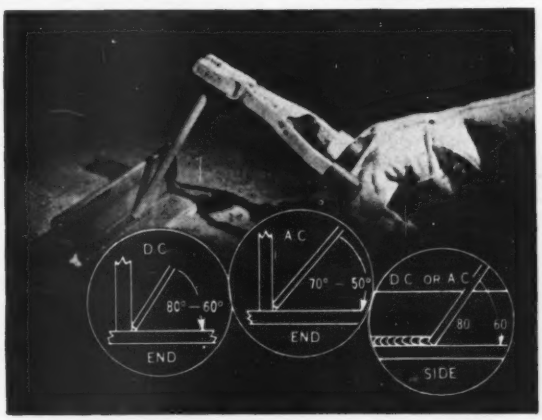


How to weld fillets 140% *faster*

Example: Single pass fillet weld in ½" plate, horizontal position.

1. **Use ¼" "Fleetweld 11" electrode, 350 amps., D. C. (electrode negative) or A. C.**
2. **Hold a short arc with tip of electrode coating touching the plates.**
3. **Hold electrode at angle shown.**
4. **Advance electrode at speed of 12" per min., keeping tip of electrode just ahead of molten pool at all times.**

RESULTS: This "Fleet-Welding" Technique, using the digging quality of the arc ("Arc Force") gets deeper penetration, minimizing amount of deposited metal required. Compared to conventional method for the example cited: It increases arc speed 140%, decreases total cost per foot 58% and at the same time increases strength 25% . . . AND THAT MAKES SENSE.



Complete procedures for all types of joints in mild steel given in handy "Fleet-Welding" pocket-size manual, Bul. 444. Free on request. Ask for it on your business letterhead.

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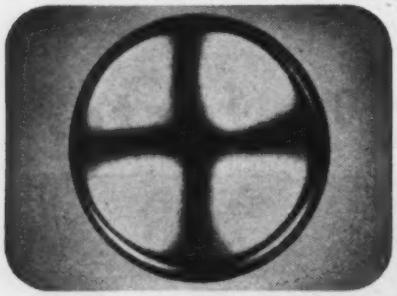
THE *Safest* EYES WEAR WILLSON SAFETY SPECTACLES

• Accurate fit for every worker—whatever his type of face—is easily possible with Willson's 20 sizes. Remember, correct fit is necessary for maximum safety. For day-long comfort, too.



• SUPER-TOUGH* lenses ward off impact hazards. Each lens is thoroughly tested. Examples: Polariscope test for uniformity of heat treatment; Federal drop-ball test for impact resistance.

• Choose from two styles. "A", without sideshields, "AS", with sideshields, (plastic, Sonite, leather, or wire screen). For glare protection, too, specify lenses in Willsonite green.

75 YEARS

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Back to Civilian Activity

Edward H. Feldmann, comdr., Seabees, becomes city engineer, of New Rochelle, N. Y., a new post created especially for him. He was engineer of sewer design for the city.

R. Preston Watts, major, and post engineer at Camp Butner, N. C., has been discharged from the Army and has been succeeded by **Capt. Edward R. English,** who is serving as acting post engineer.

Chester F. Lewis, lieutenant colonel, Corps of Engineers, member of a Greensboro, N. C., engineering firm before entering the Army, has returned to Greensboro after over two and a half years in England, France and Luxembourg. A graduate of the Massachusetts Institute of Technology, he formerly was head of the project development section of the Resettlement Administration at Raleigh, N. C., and had served as city manager of Morganton, N. C.

Arthur J. Benline, commander, CEC, USNR, has returned to his post as superintendent, Department of Housing & Buildings, New York City, after an absence of three years on military leave as commander of the 70th U. S. Naval Construction Battalion which saw service from the Mediterranean to the China Sea.

R. E. Shepherd, of Durham, N. C., major, Corps of Engineers, has returned to Durham and has established the Durham Waterproofing Co. He was area engineer at Durham from July, 1941, to July, 1942, during the construction of Camp Butner.

Sandor Mark, major, Corps of Engineers, will engage in city planning and building of houses, serving as field engineer for Jacob Mark & Sons.

John N. Calkins, lieutenant, CEC, USNR has been appointed city engineer of Ironwood, Mich. He served in the Seabees from Oct. 1942, to Oct. 1945.

Philip H. Roettger, on terminal leave from the Army Air Forces has been appointed superintendent of the Wier Cook Municipal Airport, Indianapolis, succeeding **Lt. Col. Walker W. Winslow.**

L. L. Lessig, lieutenant colonel, Corps of Engineers, and deputy district engineer, U. S. Engineer Office, Philadelphia, Pa., has returned to his peacetime position as contracting engineer for the Bethlehem Steel Co. in Philadelphia, after 3½ years' war service.

W. W. Studdert, captain, USNR, assistant to the officer in charge of construction at Camp Lejeune, N. C., in 1941-42, has been reassigned to the camp after three years of foreign service, and upon his discharge from the Navy plans to open an engineering office at New Bern, N. C.

The return to his duties as city engineer of **George S. Brockway,** recently a commander in the Seabees, has been announced at West Palm Beach, Fla.

T. C. Adams has returned to his post as city engineer for Greenville, S. C., after four years in the armed services.

James O. Kimsey, formerly superintendent of a construction company at Sparta, Tenn., has opened a general contracting firm at Greensboro, N. C. He has just been released from the Navy Air Corps after three and a half years as a pilot.

R. B. Jennings, commander, CEC, USNR, is resuming his pre-war post at Columbus, Ohio, as representative of the Trane Co., LaCrosse, Wis., after 44 months of service.

Simon W. Freese, lieutenant colonel, of the firm of Freese & Nichols, Ft. Worth, Tex., has returned after 22 months in Europe. He served as acting chief of planning of the Economic Division of the Central Council for Germany and the office of Military Government. He also served as the U. S. member to the Quadrupartite Commission for Central German Administrative Agencies.

Walter M. Culley, lieutenant colonel, SnC., for the past four years chief sanitary engineer of the Second Service Command and stationed at Governors Island, N. Y., has become assistant sanitary engineer of the National Biscuit Co., New York City.

Robert E. Carr, first lieutenant, Corps of Engineers, has joined Harry M. Evans and Guy P. Noff in the partnership of Evans, Carr & Noff, consulting and contracting engineers at St. Michaels, Md.

G. Edward Jacoby, major, Corps of Engineers, has been named assistant engineer for Grants Pass, Ore.

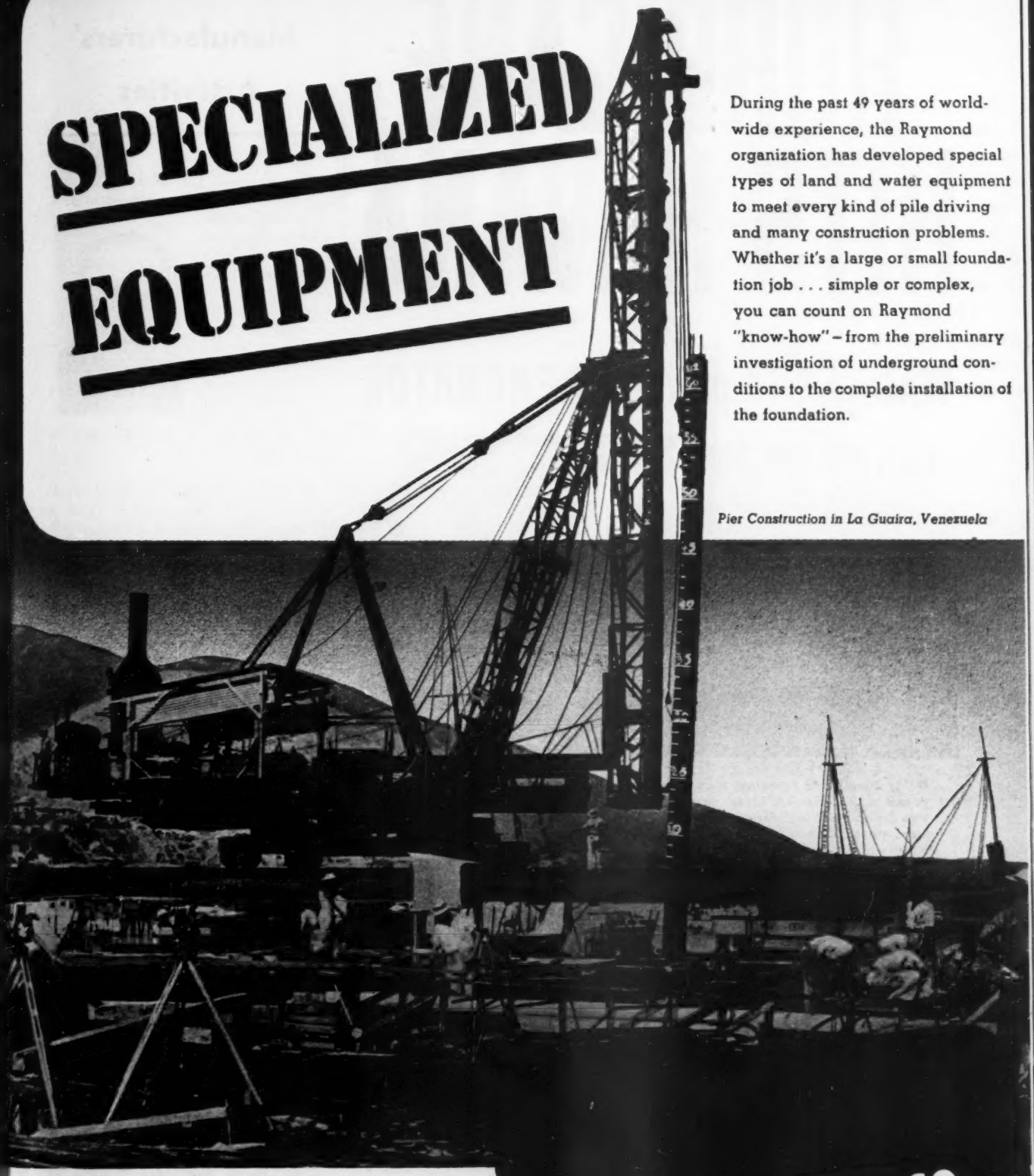
Vincent S. Bennett, lieutenant colonel, Corps of Engineers and president of Stewart & Bennett, Rochester, N. Y., contractors, is home on terminal leave, and has been advanced to a full colonel.

M. D. Mills, colonel, commander of the Mount Rainier Ordnance Depot near Tacoma, Wash., has retired from the Army and has become vice-president and general manager of the Oklahoma Railway Co. at Oklahoma City, Okla. A veteran of both world wars, Colonel Mills is a former Washington state highway department engineer and later manager of the Seattle, Wash., Transit System.

SPECIALIZED EQUIPMENT

During the past 49 years of world-wide experience, the Raymond organization has developed special types of land and water equipment to meet every kind of pile driving and many construction problems. Whether it's a large or small foundation job . . . simple or complex, you can count on Raymond "know-how" – from the preliminary investigation of underground conditions to the complete installation of the foundation.

Pier Construction in La Guaira, Venezuela



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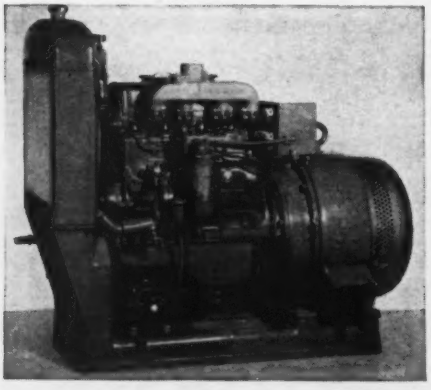
HURRICANE HITS HAVANA

...but

WAUKESHA-powered GENERATOR carries on for PAA

■ "At three in the morning, with the wind at 70 miles per hour, the industrial power at the (Havana, Cuba) airport failed," reads the Oct. 8, 1945 report of Pan American World Airways, "and automatically the emergency Kohler generators went into action." (Powered by Model XAH Waukesha Engines these Kohler units are fully automatic, with remote control starting.) "Rain seeped through the smallest cracks . . . water finally inundated auxiliary Kohler near the hangar which supplied power to the receivers . . . kept the receivers in operation for two hours by the use of airplane batteries until the water was removed . . . The spark plugs were wiped off . . . the Kohler immediately went back into action, continued to furnish power for the radio station. It is believed that the only radios operating in Havana during those four days were the ones receiving power from our Kohler plants and because of this, it was possible to continue sending weather observations to the Division Forecasting Office in Miami."



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WAUKESHA MOTOR COMPANY, WAUKESHA, WIS., *New York, Tulsa, Los Angeles*

WAUKESHA ENGINES

Manufacturers' Activities

THE SYNTRON CO., Homer City, Pa., has announced the appointment of J. A. Armstrong as district manager of the company's sales and engineering service, selling vibratory material handling equipment for the state of Michigan, with the exception of the Detroit metropolitan area. Mr. Armstrong's headquarters will be in Lansing.

W. A. FINN has been appointed export manager of the Worthington Pump & Machinery Corp., succeeding George Gellhorn who has accepted a position with a South American firm.

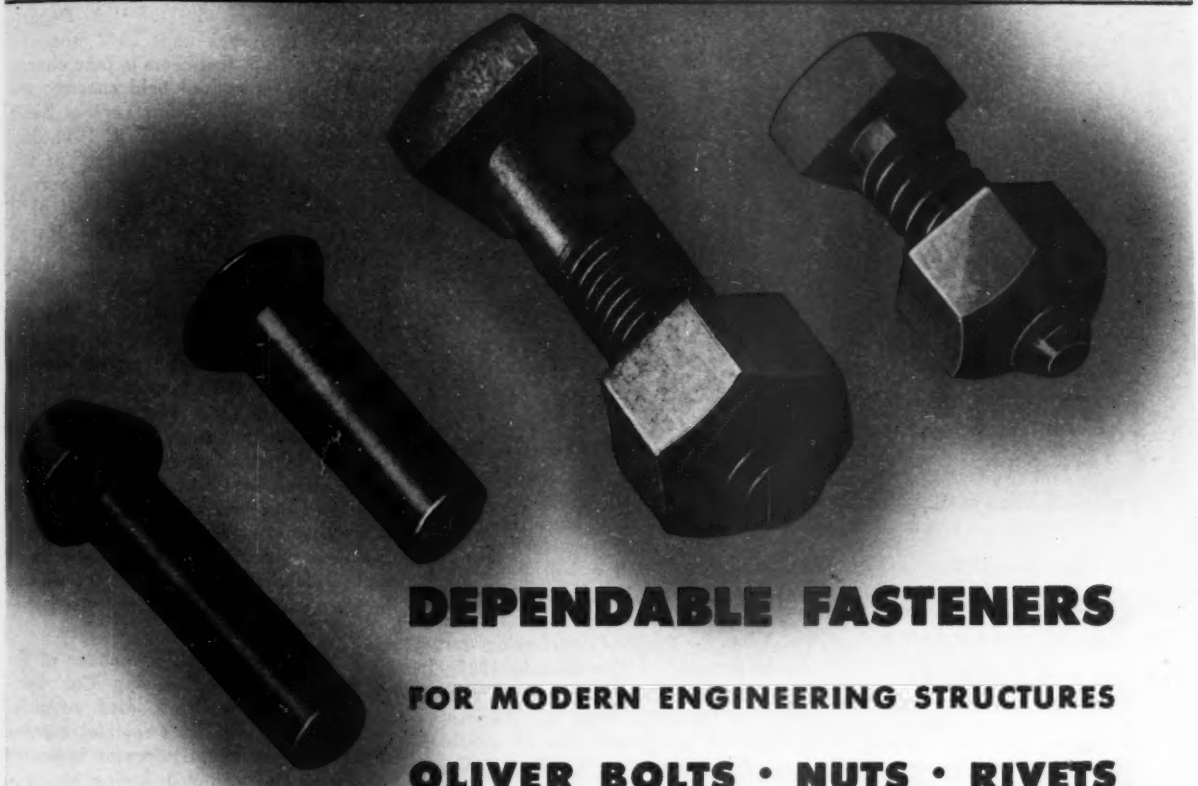
THE NEPTUNE METER CO. has announced that Herbert B. Brown has returned to the Chicago branch after Army service. Mr. Brown was formerly sales engineer for the Chicago area.

WM. B. GIVEN, JR., president of American Brake Shoe Co., New York City, has announced the purchase of Joliette Steel Ltd., one of the largest producers of manganese and alloy steel castings in Canada. The new acquisition will be operated by the present management, working under the direction of Brake Shoe's American Manganese Steel Division. Joseph B. Terbell will head the company, and J. L. Mullin will be a vice president.

THE BARIUM STEEL CORP., of Canton, Ohio, has acquired control of Globe Forge, Inc., of Syracuse, N. Y. Negotiations are about to be closed to take over also a group of companies in associated lines of the steel and manufacturing industries. This is the third time in about a year that Barium Steel has expanded its organization and activities. Late in 1944, it acquired control of Clyde Iron Works, Inc., of Duluth, Minn. and in June, 1945, it took over the Erie Bolt & Nut Co. of Erie, Pa.

Globe Forge, Inc., was founded in March, 1910, by a group of prominent business men in Syracuse including A. T. Brown and W. C. Lipe, under the name of Globe Malleable Iron & Steel Co. These two men were the founders of the Brown-Lipe Gear Corp. and Brown-Lipe-

A GOOD NAME OLIVER IN FASTENERS



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FOR MODERN ENGINEERING STRUCTURES

OLIVER BOLTS • NUTS • RIVETS

Made by one of the oldest and largest firms in the industry, Oliver industrial fasteners meet your most exacting specifications for uniformity, accuracy and strength. For speed of fabrication and the security of your structures, standardize on Oliver fitting-up Bolts, Rivets, and other fasteners.

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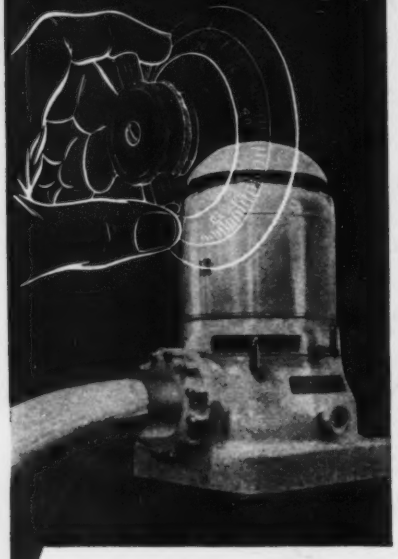
FOR L-O-N-G-E-R PUMP LIFE



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***Peerless* PERFORMANCE**
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Peerless also manufactures a complete line of Domestic Water Systems, and Horizontal Centrifugal Pumps (formerly Dayton-Dowd).

Get in touch with the nearest Peerless distributor right now if you need a new pump during 1946. He has interesting news for you.

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Chapin Co., pioneer transmission and differential gear manufacturers. In 1927, the name of the company was changed to Globe Forge & Foundries, Inc., and in 1944 to Globe Forge, Inc.

In 1926, their interests were purchased by E. R. Bishop, who had started with the company in 1910 as foreman of the die department. Mr. Bishop has been successively superintendent, general manager and president and treasurer. E. Lawton Bishop, son of E. R. Bishop who has been associated with the company for many years, has become vice-president and treasurer. E. R. Bishop will continue to act in a consulting capacity.

R. P. McKENRICK has been appointed manager of construction equipment of the Blaw-Knox division of the Blaw-Knox Co., Pittsburgh, Pa. He has for ten years been in charge of construction equipment sales in the midwestern states. Mr. McKenrick was for seven years with the Pennsylvania highway department. During the war he was project manager in charge of construction of the huge synthetic rubber plant built by the Blaw-Knox Co. for the B. F. Goodrich Co. at Louisville, Ky.

TO MEET the greatly expanded needs for packaging in southern California, the Bemis Bro. Bag Co. is increasing its production of cotton, burlap and open-mesh bags by opening a factory at Los Angeles. A building has been leased which is 415 ft. long and 145 ft. wide. Bemis is one of the pioneer industrial concerns on the Pacific Coast, having started a factory at San Francisco in 1897. In 1904 another factory was opened at Seattle. In 1941, the Bemis operations were expanded by the addition of multiwall paper bag plants at Wilmington, Calif., and St. Helens, Ore.

C. H. Dekker, appointed manager of the new factory, has been with the company for 23 years and in charge of the Bemis sales office at Los Angeles since 1939. Mr. Dekker's father opened the factory at San Francisco in 1897.

FRANK H. LEMBO has been appointed vice-president and general manager of the Jaeger-Lembo Machine Corp. of New Jersey, Newark. Maj. Joseph A. Thomas, recently connected with the U. S. Army Ordnance Department and formerly with the Jaeger Machine Co. as sales engineer, will be associated with Mr. Lembo in the New Jersey territory.

As soon as arrangements are completed, sales, rentals and service of construction equipment for the New Jersey territory will be conducted at the new warehouse in New Jersey. A complete stock of parts of the following companies represented exclusively in New Jersey, will be available: The Jaeger Machine Co., Columbus, Ohio; R. G. LeTourneau, Inc., Peoria, Ill.; The Cleveland Pneumatic Tool Co., Cleveland, Ohio; Manitowoc Engineering Works, Manitowoc, Wis.; Electric Tamper & Equipment Co., Ludington, Mich.; Diamond Iron Works, Minneapolis, Minn., and Whiteman Manufacturing Co., Los Angeles, Calif.

C. L. LAUDE, general sales manager of the Huron Portland Cement Co., has announced the addition of Joseph A. Kauer to the technical service staff under George A. Mansfield, director. Mr. Kauer spent a number of years with the Ohio Department of Highways until 1942 when he joined the U. S. Engineers to take charge of all laboratory and field concrete activities for the MacArthur Lock at Sault Ste. Marie, Mich. On Jan. 1, 1944, Mr. Kauer was selected as manager of the Ready-Mix Concrete Engineering Service in Cleveland, Ohio, and remained until his recent association with the Huron Portland Cement Co.

INTERNATIONAL HARVESTER CO., has announced the establishment of its first Pacific Coast motor truck manufacturing plant at Emeryville, Calif., in the San Francisco Bay area. Peter V. Moulder, vice president in charge of the company's motor truck division, who made the announcement, said the Emeryville works would produce six models of heavy-duty International trucks, especially designed for the highway and off-the-highway needs of truck operators in the eleven western states.

E. W. LAPLANT, 73, co-founder of La Plant-Choate Manufacturing Co., Inc., of Cedar Rapids, Iowa, died recently, ending one of the most colorful careers in the construction equipment industry.

Starting in the house-moving business in 1889, he developed equipment and technique which enabled him to move blocks of buildings and even entire towns without interrupting the occupants' routine. From house-moving he went into the design and manufacture of house-moving trucks, stump pullers and capstans. In 1912 he engaged his nephew, Roy E. Choate, as a partner and in 1927 the partnership became a corporation.

In the meantime, LaPlant-Choate began the manufacture of earth-moving equipment—wagons, scrapers and dozers—and gradually extended operations until they became world-wide in scope. Although he had been inactive since 1927, Mr. LaPlant continued as a director of the corporation until 1944.

C. F. JOHNSON has joined Watson-Stillman Co., Roselle, N. J., where he is in charge of all engineering in the forged steel fitting and the bronze and forged steel valve divisions. He will also contact the trade.

Manufacturers' Publications

Flame-hardening—A discussion of the basic principles upon which the flame-hardening process depends and operating data for applying those principles in the small shop will be found in the booklet, "Flame-Hardening Fundamentals."—*Linde Air Products Co., 30 E. 42nd St., New York 17, N. Y.*

Arc Welding Accessories—This 12-page booklet describes accessories for arc welding machines and operations, including: electrode holders, graphite electrodes, welding cable, cable connectors, and cable lugs. Also listed are: welding helmets, goggles, face shields, headgear, aprons, gloves, and sleeves.—*Air Reduction Co., 60 East 42nd Street, New York 17, N. Y.*

Centrifugal Control—A 4-page catalog describes a new model of a centrifugally controlled governor, includes installation instructions and parts list and prices. This company now provides either the vacuum or the centrifugal type of internal combustion engine control for the more popular makes of engines for transportation and industrial purposes.—*Monarch Governor Co., 1832 W. Bethune Avenue, Detroit 6, Mich.*

Pavement Slab Pumping—A booklet, "How to Detect and Correct Pavement Slab Pumping," describes and illustrates the early stages of slab pumping and goes on to outline the preventive mud-jack treatment adopted by many states and municipalities. The author J. E. Chadwick, Jr., was research maintenance engineer for Missouri State Highway Dept.—*Koehring Co., Milwaukee, Wis.*

Protective Coating—A booklet describes a covering that can be applied to metal or concrete surfaces to give positive protection against acids, alkalis, oil and water.—*Prufcoat Laboratories, Inc., 50 East 42nd St., New York 17, N. Y.*

Safety and Relief Valves—These valves are described in a new catalog which contains a pictorial index chart with line drawings of all the basic valve types. With this chart a user can pick out the valve he needs without having to thumb through a whole catalog. Directly opposite the pictorial index chart is a detailed index showing what the valve can be used for and where to find its specifications in the catalog.—*Farris Engineering Co., 400 Commercial Ave., Palisades Park, N. J.*

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Large numbers of outstanding and successful contractors rely upon the Ætna for their Contract Bonds because of the prompt and intelligent service which they receive from Ætna field representatives.

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GENUINE
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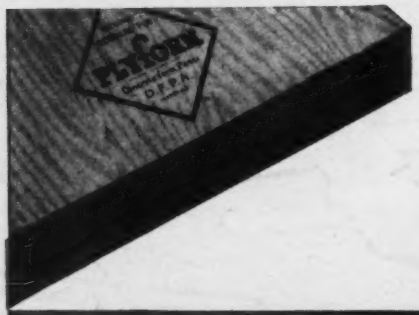
Concrete Form Panel
D. F. P. A.
INSPECTED

Every panel of genuine Douglas fir plywood PLYFORM carries a distinctive green edge-sealing and a diamond-shaped "grade trade-mark." PLYFORM is the only grade of Douglas fir plywood made especially for concrete form work.

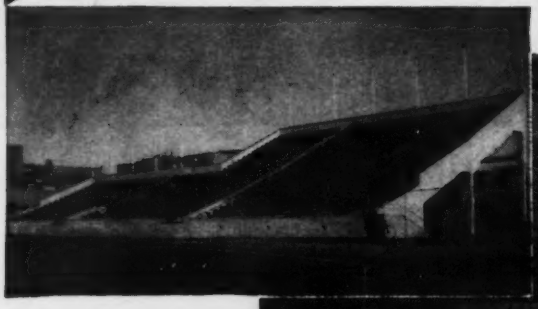
Douglas Fir Plywood provides smooth, rigid forms for better concrete jobs



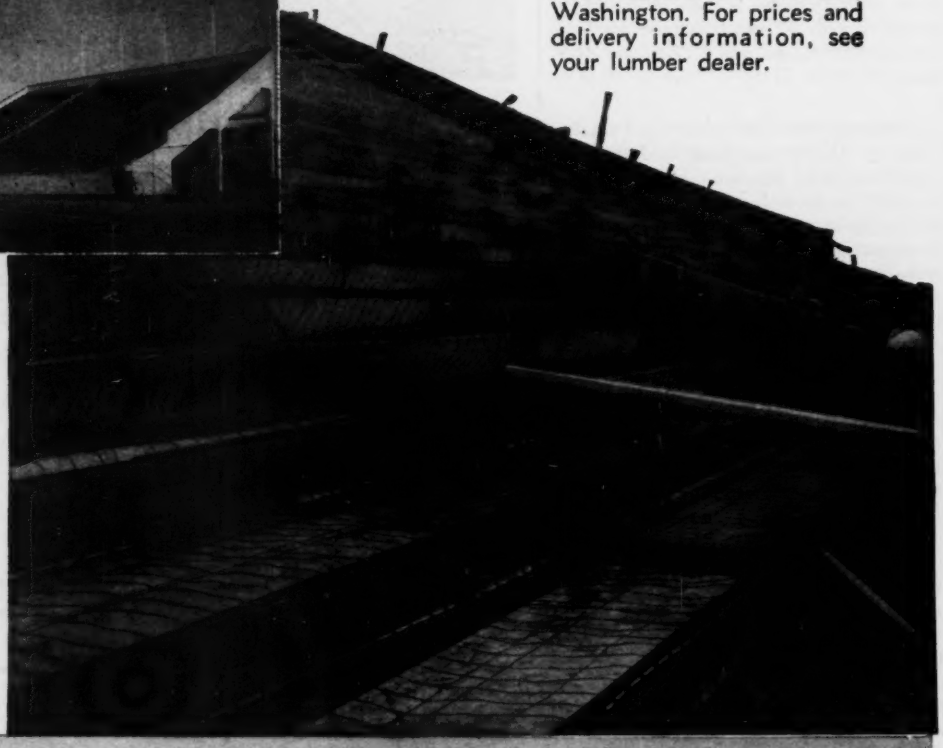
For smooth, flawless concrete surfaces—use Douglas fir plywood PLYFORM, the grade made especially for concrete form work. It's light in weight, easy to handle. It's cross-laminated in construction — strong, rigid, durable. As many as 15 re-uses have been reported.

Because PLYFORM panels are sanded satiny smooth they produce concrete surfaces that are really **smooth.** Joints and fins are held to a minimum. Rubbing costs are reduced.

Take advantage of PLYFORM'S many outstanding qualities. For technical data on this proven product, write the Douglas Fir Plywood Association, Tacoma 2, Washington. For prices and delivery information, see your lumber dealer.



Above: Completed bleacher section of a high school stadium in Los Angeles. PLYFORM gave the concrete work a smoother, more attractive finish.



Right: A close-up of the PLYFORM forms in the bleacher section, before stripping.

Douglas Fir Plywood Association
Tacoma 2, Washington